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EDITORIAL

MINOR AND OFFICE SURGERY

WHAT may be considered minor surgery and the point at which it becomes major, as well as what surgical conditions may properly and with safety be attempted in a physician's office, have been and still remain debatable topics. We have no wish to interject our opinions or line up with those on either side of the controversy.

We realize, however, that throughout the country and among many of our subscribers are men practicing in what are called rural or the "smaller places," as well as men in cities who do not devote all of their time to major surgery. These men, by no stretch of the imagination, can be classified as specialists in any branch of surgery. Part of their work must embrace the routine duties of the general practitioner. In addition, they must be prepared and able to handle those so-called minor surgical afflictions common to mankind. The urban center with its large, well equipped hospitals and clinics, staffed by all manner and degree of specialists, often are many miles away. The physician serving his community must stand on his own feet and know how to meet and handle the emergency, be it major or minor. If he would continue in that community he must know how to do many minor procedures for so-called minor surgical conditions.

Recently, Dr. Eugene H. Pool, Professor of Surgery, Cornell University Medical College, in an address before the New York Academy of Medicine, pointed out:

> The treatment of the common injuries is touched but lightly in the medical school and at surgical meetings. The application of a bandage, the suturing of a wound, the care of local infections and the treatment of fractures and dislocations are relegated to secondary place in the efforts of the teacher of surgery. Yet modern conditions have brought injuries and occupational diseases and hazards to a position of primary importance to the community.

Inasmuch as the line of demarcation between major and minor is so ill defined, some of the contents of this number may be considered out of their sphere, and rightly so; others may strike the reader as too minor. But what one knows the other may not know. The effort must be judged by the whole and not by the individual parts.

Topics and authors were selected with care, and we wish especially to express our appreciation to Doctors Walter Coakley, Bradley L. Coley, L. Kraeer Ferguson, Herbert C. Fett, James Graham, Charles Gordon Heyd, Joseph A. Hyams, Arthur Krida, Jerome M. Lynch, Louis E. Phaneuf and Max Thorek for their help and counsel in arranging this number.

To the authors who so kindly gave of their time in preparing papers on these common, minor topics we give our sincere thanks.

Frankly, this issue was not designed for the surgeon of great skill and wide reputation, or for the seasoned teacher of surgery or its branches. It was designed for the men laboring in the far away places, and to them we hope it will prove of practical help and value.

T. S. W.

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WOUNDS AND THEIR COMPLICATIONS

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THE very common subject of wounds looms larger and larger these later days as swiftly moving vehicles create havoc upon our highways. Incised wounds are commonly due to windshield glass that breaks and divides tissue, often of the face. If the larger vessels of the neck, arm, groin or thighs are opened, a percentage of the victims die of uncontrolled hemorrhage, usually because bystanders do not understand the application of an improvised tourniquet or do not realize that hemorrhage even from a large vessel may be arrested by pressure or by pinching the artery between the thumb and finger until expert assistance arrives. When the injury involves the very vascular tissues of the head, satisfactory healing should occur after thorough mechanical cleansing despite the free use of antiseptics and even some degree of tension. The wound may be flooded with one-half strength tincture of iodine, grease removed with turpentine or ether, dirt-begrimed tissue trimmed away and after adequate hemostasis, bleeding vessels controlled with very fine (000 to 0) plain catgut or wire, then united very accurately with 35 gauge rustless steel wire or horsehair, without drainage, and healing free from reaction may be expected.

Apart from a permissible compression bandage to limit oozing during the first twenty-four hours, no dressing for wounds of the face is necessary. Dressings about the openings of the mouth, eyes and nose are particularly objectionable as they retain decomposing secretions in contact with the wound. Infection or a poor cosmetic result from an incised or even the average lacerated wound of the face or scalp, as a rule, indicates a slipshod operation or lack of surgical skill.

When a part of less vascularity, as the hand, or particularly the foot, is involved, much greater care is necessary in order that the vitality of the tissues be not destroyed by manipulation, strong antiseptics, the tension from tight sutures or lack of rest. Here the part should be given absolute rest, at least until primary union has occurred, and should the injury be at all extensive, general rest by keeping the patient in bed. Rest favors minimal exudate, primary healing and early recovery, and insures against the spreading, destructive infection so often seen when partly devitalized and contaminated tissue is subjected to early movement. Drains are not to be used unless the patient falls into such shock that the operation cannot safely be prolonged. They provide a path for the entrance of surface bacteria to the depths of the wound. At times, they are used to salve the conscience of the operator who knows he has been inexcusedly careless in his wound sterilization or hemostasis. A drain is justified in a clean wound only for uncontrollable oozing. Even in the most radical amputations of the breast, we do not use one. As a rule it is better to occasionally evacuate a sterile hematoma between stitches at the second or third dressing than to risk having the wound contaminated through a drain.

To reduce scarring, alternate sutures may be removed from the face or scalp, provided there is no tension, on the second or third day and the remaining sutures on the fourth or fifth day. With wounds of the limbs or trunk supporting sutures should be left in for a week, with the foot for eight days, or if the wound is under tension or there is a strain upon divided skin, fascial or aponeurotic planes, an adequate

number of supporting sutures to prevent separation should remain in place for from ten to fifteen days. Should infection develop, stitches are to be removed and wet, warm, non-irritating dressings used. A deforming or unsightly scar may be excised three or more months after complete healing and the edges of the wound then coapted with meticulous care.

Contused closed wounds with or without fracture are characterized by tissues so bruised and devitalized as especially to be subject to necrosis and infection. Of particular danger in extinguishing the limited residual life of the part is the tension resulting from hemorrhage and edema. If tension is prevented, tissues that seem to be hopelessly damaged and are therefore thought to require amputation, frequently recover in a surprising way with little evidence of infection or necrosis. Tension results chiefly from the restraining skin and fascia which in a severe crush or contusion should be divided freely in the axis of the limb, if necessary on two sides. The divided skin and fascia will then separate widely. If the sheaths of muscles are also tense, these should be freely opened. The skin should, of course, first be carefully cleansed with ether or turpentine followed by tincture of iodine of 3½ per cent strength. Bleeding vessels should be ligated with fine (No. 35 B. and S. gauge) soft alloy steel wire, and fractures should be reduced without internal fixation or undue manipulation. If there is a marked tendency to displacement, continued extension by Kirschner wire or Steinman pins may be used. A very copious wet dressing of warm 1–4000 bichloride of mercury on fluffed gauze surrounded by cellophane or similar impermeable layer and finally a heavy encasement in sterile cotton, held by a lightly applied supporting bandage, is used. Unless complication develops, the dressing should not be removed for three or four days. This is the treatment to be used for crushing wounds of the extremities during the early period while there is any question as to the viability of the tissues. In many severe cases it enables one to best determine the necessity for amputation.

Case 1. A brakeman was admitted with his forearm crushed nearly flat between the bumpers of an old-fashioned freight train; the skin was tense, no pulse was detected at the wrist, and there were multiple fractures of the radius and ulna. Immediate amputation through or above the elbow was considered essential by consultants.

Treatment. Following sterilization of skin, one volar and one dorsal incision was made through the skin and fascia from the elbow into the hand. The muscular sheaths were found to have been crushed apart. The multiple fragments of the radius and the ulna where displaced, were gently pushed back into position and overlaid by muscle. Warm, wet antiseptic dressings were applied as described above.

Result. Granulation and healing of the widely open wounds occurred without necrosis or loss of tissue and there was bony union with a strong somewhat flattened forearm of excellent function.

Many surgeons have hesitated to incise badly contused parts or at the most have attempted to relieve tension by inadequate multiple punctures. Where the vitality of a limb is in jeopardy from a crush, all tension should be released aseptically by one or more long incisions reaching from uninjured tissue above to uninjured tissue below.

On the head, neck and trunk, the vitality of the tissues is so great that the long relaxing incisions mentioned are rarely necessary. However, large hematomas may produce serious pressure symptoms so that aseptic evacuation through a large aspirating needle or by incision may be indicated, preferably some days after the primary hemorrhage has ceased. If a large artery such as the iliac, femoral or axillary has been ruptured, the state of shock, the vitality of the limb, the local damage to the tissues, the ability to temporarily control the flow of blood from the artery and the skill of the surgeon should all be evaluated. An emergency operation upon a badly shocked patient with a ruptured main artery has a high mortality and is indicated

only when it is evident that the hemorrhage or oncoming gangrene will cost the life of the patient in which case there should be no delay. If the patient is in fair condition and the bleeding can be controlled above the field of injury by tourniquet, direct compression, or temporary ligation of the artery, it may be possible to evacuate about the artery and do an arterial suture, or at least determine the necessity for an amputation. In the average case a pressure pad, and a bandage evenly applied from the phalanges to a point above the injury will limit the size of the hematoma, and the operation for the false traumatic aneurysm may be delayed until conditions are more propitious.

In all cases the toes or fingers should be exposed so that interference with the circulation may promptly be detected. If pain continues, the surgeon should search for the cause without delay. An overlooked dislocation, an unreduced fracture, a tight bandage or cast, a beginning pressure sore, or an iodine or hot water burn are common causes of distress that should not be neglected. In one little girl the physician made traction for a broken leg through a shoe despite the child's suffering. After two weeks the removal of the shoe revealed great sloughs, exposed tendons and a permanently crippled foot, all due to the pressure of the shoe. An uncomplicated wound should not cause intense pain.

Contused and lacerated wounds including open crushing injuries have the element of potential infection, the avoidance of which depends largely upon the first treatment. The surrounding skin should be asepticized, the wound flooded with 3½ per cent tincture of iodine and mechanical sterilization of the wound carried out by excising with a very sharp scalpel all tissue that is devitalized or impregnated with dirt. Bone containing dirt should be removed with a sharp chisel, not by scraping. Vessels should be ligated with fine alloy steel wire as most other materials form a nidus for infection. Such wounds of the head and face, and most wounds of the neck and trunk may then be immediately and very accurately closed without drainage with the fine (No. 35 or 36 gauge) annealed rustless steel wire. With a meticulous technique primary union with slight scarring is to be expected. There is little excuse for the suppuration of any wound of the scalp or face. In children under ten years of age, with wounds of the neck, in Negroes and others with a constitutional tendency a keloid thickening of the scar may develop.

With a lacerated wound of an extremity, tension and lack of blood supply may cause the loss of the patient's limb or his life. The treatment of crushing and lacerated wounds of the extremities consists therefore in careful debridement with the least possible traumatism to living tissues and the prevention of tension, if necessary by very long incisions in the axis of the limb carried freely through constricting skin, fascia and muscle sheath as previously described. Skin sutures are only permissible where and when they produce no tension. Copious warm, wet antiseptic dressings are valuable. Distal portions of the arm or leg that hang from what seems like only a small pedicle of soft tissues may not infrequently be saved.

Case II. One hand of a man was lacerated and contused by the explosion of a bomb he was holding. The thumb and metacarpal bone were dangling from a ribbon of soft tissue 2 cm. wide containing a small branch of the radial artery. The head of the first metacarpal was fragmented and many phalanges were fractured, and two fingers were lacerated, pale and bloodless. Amputation of thumb was urged by several consultants. The thumb and bony fragment in the joint were replaced and held in position by a few fine sutures in the muscle, the skin and fascia not being sutured but copious, warm, wet, antiseptic dressings were applied.

Result. Healing was without suppuration or necrosis with restoration of one-third of the normal movement of thumb.

Böhler leaves the wound entirely open and exposed to the air, protected from dust only by a single layer of muslin and obtains excellent results. He obtains reduction and retention of compound fractures by the Steinmann pin or Kirschner wire passed

through the bones at a distance from the injury and held in a supporting frame.

With severely contused and lacerated wounds of an extremity after sterilizing and debriding the wound, divided parts may be gently apposed, but not to the extent of adding to the tension or traumatism. The prevention of secondary tension or retention of secretions is the first consideration; formal anatomical restoration often is best delayed until the vitality of the tissues has been regained. A common mistake with lacerated wounds is meticulously to suture divided muscles, tendons, nerves and skin with resulting tension, necrosis and spreading infection.

Case III. A lacerated wound of the hand with division of the tendons and a fracture of the metacarpals resulted from the fall of a large wheel. Two hours were devoted to the immediate careful suture of divided tendons, alinement of bones and closure of the skin.

Result. A widespread infection involved the forearm and the hand, lasted for months and resulted in a disorganized and nearly useless member.

Thorough debridement is especially important if there is the likelihood of bacterial contamination as in wounds from gunshot or the fang or claw of lower animals.

Case IV. Lacerated wounds of the hand with fractured metacarpals resulted from bite of a large monkey. All the wounds were sutured and covered with gauze dressing.

Result. A prolonged, agonizing infection, swollen, very painful, crippled hand with septic osteitis and purulent sinuses one year later.

Case V. Dog bites of both hands and wrists were treated by antiseptic cleansing and gauze dressing without debridement, relaxing incisions, warm, wet, antiseptic poultices, or immobilization.

Result. Infection with final loss of one hand and crippling deformity of the other.

Infection by the Bacillus Welchii. The spores of the gas bacillus carried into the wound with minute particles of woolen clothing, intestinal discharges or street dirt are not destroyed by permissible antiseptics, and cannot certainly be removed by debridement. The gas bacillus and related organisms however seem unable to start infection in a well vascularized living tissue. It is in devitalized muscle, or in muscles the blood supply to which has been arrested by the injury or by the secondary tension within the sheath that this organism colonizes, causing a putrid form of gangrene that with much gas and liquid exudate spreads from muscle to muscle. A wound may contain many spores of the Welch bacillus and yet heal without reaction. Other pathogenic bacteria may likewise remain in a wound without harm, provided no semidevitalized, dead tissue or blood clot is present.

One should think of gas bacillus infection after any crushing or gunshot injury, especially of the extremities, when there is delayed or increasing shock without loss of blood sufficient to cause the symptoms. Prostration and a rapidly rising pulse rate with cold skin and high rectal temperature are common findings. The crackling of the tissues on palpation, the gas in and between the muscles shown by roentgenogram, the later foul, brownish, gas-filled wound secretion are pathognomonic. Dependence should be placed early upon the wide opening of the limb and the removal of all devitalized soft tissue. Often this necessitates the excision of entire muscles which may be pale and firm as if cooked. For the advanced case with the patient delirious, nearly pulseless and apparently moribund, a high guillotine amputation is at times life-saving.

The Welch organism may remain in the tissues for months and produce gangrene only when the muscle is damaged or becomes avascular.

Case VI. An aneurysmal dilatation of the anterior tibial artery in a young man was caused by the entrance of fine bird shot about fifteen months previously. There was no inflammatory reaction in the leg. The angiomatous mass was resected, and one or two bird shot was removed from apparently healthy muscle. The open muscular sheath was sutured under marked tension and without drainage. Rapid development of gas gangrene in the leg followed with death within seventy-two hours

despite the injection of two hundred dollars worth of combined Welch antitoxin. In this case the Welch bacilli or spores carried into the tissues with the bird shot had remained dormant until tension interfered with the blood and lymph circulation in the muscle, when they rapidly developed to then swarm out and overwhelm the body.

Thyroid crisis may be precipitated by injury, a relatively slight operation or even a mental shock, with increasing tachycardia, tremor, restlessness, progressive hyperpyrexia (by rectum) and at times death in twenty-four or thirty-six hours. The crisis is to be suspected if there is a visible or a palpable goitre or thyroid nodule, but it should be remembered that the goitre may be entirely intrathoracic and only visible on the roentgen film. In such a case the high internal temperature is especially dangerous for the central nervous system. Adequate refrigeration, the free use of iodine and glucose solutions by vein and iodine by mouth and rectum are the best known methods of treatment.

ANTISEPTICS

Progressive repair, reduced toxemia and rapid elimination of necrotic tissue are very much more important than high bactericidal action of the antiseptic applied to the wound. A healing contaminated wound is preferable to a sterile dormant wound. Many of the newer antiseptics, while they may have high bactericidal power, when they are applied to the wound produce a sluggish condition with delay in healing. A similar retardation of healing occurs when the dressing is impregnated with certain of the older germicides, such as solutions of formalin, carbolic acid, lysol or other cresol. None of these substances should be used as a wound dressing. As is well known, a wet dressing of even a weak solution of carbolic acid has produced gangrene of fingers and toes. On the other hand, granulations grow rapidly under a weak wet dressing of bichloride of mercury, iodine or even bromine. Bromine in 1:3000 to 1:5000 strength has a special value for very fetid wounds.

Dakin's solution is not applicable in ordinary practice and should only be used when the wound is wide open. Injected into the fresh wound under tension it produces necrosis. In the abdomen it dissolves the mesentery down to the blood vessels. It is essential that it be applied copiously every two hours following the very precise technique elaborated by Carrel.

For irritated wounds or where the skin is excoriated, liquor aluminii acetatis of the National Formulary, diluted 1 to 4, is of value. For tissues of low vitality as in a diabetic or arterosclerotic the mildest and least irritating antiseptics only should be used.

SUTURES

Sutures have attracted more and more attention during recent years. We must remember that, while absorbability is very desirable, all sutures derived from lower animals are objectionable. Catgut produces reactions which retard healing and favor infection. It is especially harmful in infected wounds and on mucous surfaces. After thyroidectomy, surgeons have long wondered why it was that the wound became edematous, required drainage and did not heal as well as other wounds of the neck. It was thought that the secretion from the thyroid or the exposure of the trachea was responsible. We were impressed likewise until after we studied the undesirable reactions of the tissues to catgut in about 130 patients. Implanted in the skin catgut causes a red flare and a wheal in twenty-four hours which so progresses that at the end of a week there is a zone of reaction and necrosis about each strand. Thus firm healing is delayed until the catgut has been absorbed and the local damage to the tissues from the catgut repaired. From silk there is only a slight redness at the end of a week; from rustless or alloy steel wire no flare or wheal even at the end of four months. With the substitution of silk or wire for catgut in thyroidectomy the wound heals like other wounds of the neck without reaction or drainage. The wire tied in a small knot and placed in a septic

wound, becomes buried without producing local irritation or a sinus. Therefore, we have used it increasingly for several years past, burying it in abdominal wounds and in hernioplasties, and using it as the sole material for suture and ligature in infected or contaminated wounds. We believe it solves much of the difficulty in closing cleft palates, duodenal and vesicovaginal fistulas, the suture of the ureter and bladder. Size 35 and 36 (B. & S. gauge) is hair-like and is used for fine plastic work and fine ligatures; No. 32 and No. 30, about the size of 000 or 0000 catgut, but much stronger, are used to unite strong fascias or as a through and through suture; size 18 to 22 is very strong and is used to wire bone.

Suturing with living fascia to me recalls the barbaric surgery of savage tribes. Heavy coarse needles open great holes in delicate aponeuroses and crudely weave bands of fibrous tissues into the depths of the wound. I am informed that the younger Coley is soon to publish the end results from the method in treating hernia with a report of about 17 per cent of recurrences.

Residual infection should be considered with a wound that has been seriously infected but has healed. Therefore, how long a delay should be practiced in such a case before re-operation is done for an ununited fracture, divided tendons or nerves? Usually at least three months, but it is best to first test the part by free manipulation under gas anesthesia. If this is not followed by serious local reaction, the operation may be done. If it is followed by a marked local reaction or what occasionally occurs, the development of an abscess, of course, a much longer delay should be practiced. With infected fractures during the inflammatory period before free suppuration has been established, operative manipulation may produce a fatal septicemia.

THE APPLICATION OF COLD OR HEAT

Cold retards healing and the resistance of the body to infection. It has little germicidal value, although it may reduce the activity of bacteria. Warmth favors wound healing and high temperatures that are tolerated by peripheral tissues markedly impair the pathogenicity of a number of bacteria. Fever, kept within such limits that the central nervous system is not injured, is a valuable therapeutic agent in infection. Therefore, an injured part should be kept warm. Refrigeration is only to be considered in the early hours of a rapidly destructive local infection to hamper bacterial activity until there is time for protective bacteriolytic and antitoxic substances to be formed. Even in this early stage heat may serve a better purpose. Ice bags or cold solutions should not be used upon tissue of low vitality.

INFECTED WOUNDS

Infected wounds may be divided clinically into two great classes. In the first class we operate; in the second we wait. *In the first early operation cures; in the second it kills.* This applies not only to wounds, but also to peritonitis and other forms of infection. The first class is typified by the staphylococcus which forms an endotoxin and an exotoxin which act upon endothelium with the production of thrombi in blood and lymphatic vessels and plastic exudate on serous surfaces. The thrombi and plastic exudate block off the infected area from the rest of the body, limiting the general reaction, but causing a local ischemia and necrosis. Thus the center of a boil or carbuncle dies and may later be expelled as the "core." In the skin the localized thrombosis may lead to limited areas of gangrene. The local tension from the inflammatory exudate increases the damage. Thus the process may be arrested or limited by early incisions or, as with a carbuncle, by excision of the thrombosed area. In osteomyelitis the destructive inflammation may be at once arrested by the early drilling of the bone with a gimlet to relieve tension. With a beginning furuncle we may arrest the process by destroying the microorganisms before the thrombotic process has fully developed. To this end 0.5 to 2 minims of liquified phenol is injected through a very fine needle into the center of the boil, a procedure not to be used on

the fingers or toes. For the more superficial pustulations on hairy surfaces as the scalp or axilla, the frequent application of undiluted tincture of green soap with exposure to the air is particularly beneficial. For an extensive staphylococcic cellulitis free incisions and warm, wet dressings of 1:5000 bromine solution are valuable. In peritonitis the exudate is protective and is not to be removed. Years ago Dudgeon and Ross showed that a mixed colon bacillus and staphylococcic peritonitis was less dangerous than a pure colon bacillus peritonitis. Infections by the staphylococcus, the pneumococcus, the bacillus pyocyaneus, the gas bacillus we treat by sterilizing, incising or debriding early. Free drainage, no sutures, wire instead of catgut ligatures, warm, wet antiseptic dressings and rest are important. Against a few of these infections there is an antitoxin of some value.

Class II is represented by a group of pathogenic microorganisms of which the streptococcus is a striking example, that do not as a rule produce thrombic and plastic exudative reactions and, therefore, tend to any early and wide diffusion through the blood and lymphatic channels. The exudate, as a rule, remains liquid, but often causes a marked edema with redness, swelling and pseudo-fluctuation suggesting an abscess. Usually this exudate is finally spontaneously absorbed. The general reaction may be early and marked and a bacteremia established in a few hours. For example, a surgeon pricks himself while operating for a streptococcic infection. In two to four hours there is a chill and fever and red tender streaks mark the spread of the coccus through the lymphatic vessels radiating from the wound. If the puncture is incised or excised, additional lymphatic spaces are opened, a more severe chill, higher temperature and death from blood stream infection commonly follow. The proper treatment is immediate absolute rest in bed. The lymphatic circulation should be reduced by keeping the extremity splinted, but not constricted. The wound should be covered with an antiseptic ointment, as unguentum oxidum flavum or a wet dressing, and not handled, squeezed, incised or disturbed. To supply complement, a transfusion of 150 c.c. to 200 c.c. of typed blood should be given every third day until the temperature remains normal.

If the donor will permit, the richly leucocytic blood of an immuno transfusion may be used. Fifty million killed typhoid bacilli are injected into the donor's blood stream with resulting chill, sweat and fever. Six or eight hours later, or at the height of the resulting leucocytosis the transfusion is made. Transfusion has a high mortality in infancy, and many more babies have been killed than saved by the injection of blood.

In acute osteomyelitis we have examples of the two classes of infection. The common form occurs in childhood or youth, is due to the staphylococcus, and may be aborted as previously mentioned by venting the bone. The second type, due to the streptococcus develops in infants, and the mortality is markedly increased by early operation.

Anthrax also belongs in Class II. The pustule which closely resembles that of vaccinia is usually seen in those who work with imported hair or hides. Formerly the lesion was excised, cauterized, injected with carbolic acid, or other antiseptic solution, and this militant treatment resulted in a fatal anthrax septicemia in 30 to 50 per cent of the patients. Now we keep the patient in bed, protect the pustule from movement, scratching and meddlesome consultants, with a layer of yellow precipitate ointment, thick soft dressings and a splint, and about 95 per cent of the patients recover within two weeks.

DRAINS

While the mortality may be greatly reduced by delay in draining a mixed streptococcic appendiceal abscess, if the pus is then drained through the free peritoneal cavity, 6 per cent or more of the patients will die of peritonitis. We, therefore, prefer to make a muscle splitting incision close to the right anterior iliac spine, strip the unopened peritoneum from the hollow

of the ileum, and locate the abscess from behind the peritoneum by the finger, which also guides a closed curved Mayo scissors into the abscess cavity. The scissors is then opened and withdrawn and a drain introduced. This method, if it can be carried out, largely eliminates the late mortality.

Deaths from the Early Removal of Drains. With a virulent, and especially a Class II infection, gauze drains should not be removed before the ninth day or before they have loosened spontaneously. After draining for septic appendicitis, or any streptococcic infection, do not let an interne or anyone else pull out the drain on the second or third day. The lymphatic spaces are thus torn open, a chill and rising temperature frequently follow, with death from a blood stream infection. In one year in one hospital in Philadelphia 6 deaths were attributed to this cause. Remember also that drains often fix the infection. Those who in peritonitis drain to the bottom of the pelvis have the greatest percentage of secondary pelvic abscesses. Again, a gauze drain should rarely be renewed. When impregnated with wound secretions it becomes more of a cork than a drain. If continued drainage is necessary, fill a glass syringe with a modified Beck's plomb, 25 to 50 per cent of bismuth subiodide in white petrolatum. Squeezed into the wound without tension, this causes no pain and facilitates drainage and early closure. It may be renewed without undue pressure only every four to eight days.

SKIN GRAFTING

Granulating wounds if large may epithelialize so slowly as to greatly retard convalescence. Skin grafts are often applied when a quicker and much better result could be obtained by sterilizing the granulatory surface with a 10 per cent solution of chloride of zinc, blotting and excising the granulation tissue with a sharp knife and then liberating the adjacent skin, which is slid over the defect and sutured. The area may be so large however that skin grafting is desirable.

It is to be remembered that only autogenous grafts live. Not many years ago attempts were made to graft frog skin, the lining of an egg, and the bones of dogs into humans. None of these tissues endure. We cannot even graft skin from a mother to a child, or from one member of the same family to another, unless they are homologous twins.

Only autogenous grafts, grafts made from the same person, will survive. It is true that a graft from perhaps a related person may appear to "take" for one or two weeks, but then it melts down and finally disappears, although one may be misled by the fact that some living sebaceous or sweat glands remaining in the grafted area have in the meantime started to form new islands of skin. The cosmetic result from small Thiersch or pinch grafts is very poor. Large Thiersch grafts, split skin grafts or fitted and sutured full thickness grafts should be used, especially on exposed portions of the body. To ensure a successful "take" the even compressure from rubber sponges incorporated in the dressings is important.

SUMMARY

The treatment of the various types of incised, contused and infected wounds is notoriously poor in a large percentage of our hospitals as well as in private practice.

Disfigurement, mutilation and even death daily express the widespread failure to appreciate and apply the simple principles underlying the surgery of traumatism and infection. Methods of treatment for incised, contused and infected wounds are described and errors illustrated by concrete examples. The selection and application of sutures, ligatures, antiseptics and dressings are indicated and the great danger from transfusing babies mentioned. Methods of preventing or aborting infectious processes are given.

Common tragedies from intervention in Class II infections and from the mishandling of drains are emphasized and attention is directed to the faulty use of skin grafts.

TREATMENT OF OPEN INFECTED WOUNDS

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WOUNDS become infected because bacteria are present, grow and multiply within them. The mere presence of bacteria in a wound does not mean that it is infected but rather it is considered as a contamination, and probably exists in every wound, surgical or traumatic. In the clean surgical wound the contamination is usually so slight that the bodily defenses dispose readily of the bacteria and make healing by first intention possible. In traumatic wounds seen within the first few hours surgical cleansing combined with body defenses will often produce the proper conditions for primary union.

If a wound becomes infected all thought of primary union must be abandoned. The attention of the surgeon must then be turned to controlling the infection and promoting healing by second intention. The wounds which must be treated as open infected wounds fall into three classes as follows:

1. Wounds which have been sutured and have become infected;

2. Wounds which have been made surgically in the treatment of preexisting infection-incisions;

3. Contaminated wounds in which the surgeon believes that infection is bound to occur, either because of the degree of the contamination or the time elapsed before treatment.

When a wound heals by second intention it heals *from the bottom up*. Its surfaces throw out granulation tissue which fills the defect. From the skin edges new epithelium advances over the top of this accumulation until all is covered. Then follows a gradual devascularization and contraction of the granulation tissue until the scar reaches its final form—contracted, avascular, white—many months later. Why does this process start? Why does it stop when healing is completed? The answers to these questions lie deeply buried among the mysteries of Nature.

In the vast majority of cases infected wounds heal spontaneously with no care other than cleanliness and protection; "We dress the wound, God heals it."

There are a few ways in which we can be helpers as well as interested observers in this process of wound healing.

CONTROLLING THE INFECTION

By applying aseptic precautions we hope to keep bacteria from entering a wound. By its very definition an infected wound already has bacteria in it. The question naturally arises, "What is the use of observing aseptic precautions in a wound that is already septic?"

In its early stages an infected wound is always surrounded by a greater or lesser amount of cellulitis due to the *penetration inward* of bacteria and their toxins. This is evidence of the fact that its surfaces are not sufficiently walled off from the surrounding tissues and that they are still permeable to infection. Due to the effects of time, or the relief of tension by proper drainage, or both, the wound becomes impervious to infection. This is evidenced by the fact that the cellulitis subsides and the surfaces become covered with healthy granulations. Healthy granulation tissue, although more fragile, is nearly as impervious to infection as the skin itself.

Therefore, *asepsis is necessary in the early stages while the surfaces of the wound are still permeable.* True, the wound already harbors bacteria of one or more types; nevertheless, it is important not to intro-

duce some other type which might make more trouble than the ones already there.

Asepsis is not necessary after the wound has become impervious to infection. This stage is reached after all tension has been released, after all cellulitis has subsided—after the surfaces have become covered with healthy granulations. When a wound reaches this stage gross cleanliness with soap and water is infinitely more important than the microscopic form. The patient can often take care of such a wound himself as long as he observes normal care in washing and protecting it.

THE DRESSING

Frequent dressings are desirable for purposes of cleanliness if for no other reason. As has been already stated, aseptic precautions should be strictly observed in the early stages but are not so important later. Gross cleanliness should be observed at all times. The free use of soap and water is highly recommended. Purulent exudate should be cleaned away and crusts should be removed. Good mechanical cleansing always makes a wound feel better. An ointment dressing is more comfortable than a dry one, vaseline or boric ointment being as good as any. This measure promotes free drainage by hindering the formation of crusts and also prevents the discomfort caused by dressings that stick.

While the wound is sensitive it is always more comfortable if the dressing is voluminous. The application of a comfortable dressing is an art in itself.

CARE OF GRANULATION TISSUE

It is important that the granulation tissue should be healthy at all times. If it loses its vitality, healing is delayed and the danger of reinfection of the surrounding tissues increases. Healthy granulations are pink and shiny, and bleed easily. Unhealthy granulations lose their lustre, become dark red and may be covered with a greenish grey exudate. Healthy granulations are the rule in normal, healthy individuals. Nevertheless, any granulation tissue may become unhealthy, especially in wounds about the ankles and feet where the circulation is not as good as in other parts of the body. Unhealthy granulations may be restored to vigor by rest, elevation of the part, heat and moisture. Normal salt solution is as good as any for hot soaks and wet dressings. Dry heat and sunlight are also beneficial.

At other times the granulation tissue may be too vigorous. It may grow so fast that it advances above the skin surface before the new epithelium has a chance to grow over it, with a consequent delay in healing. In such cases it is necessary to demolish these exuberant granulations. This can be best accomplished by cauterization with a stick of silver nitrate. Great care should be taken not to damage the delicate new epithelium at the same time.

SHAPE OF THE WOUND

The wound ideally shaped for healing by second intention is the one that has its greatest area at the skin surface. This gives the greatest opportunity for the defect to fill with granulations before the skin grows over the top. It also allows the freest possible drainage. This ideal should be borne in mind while preparing a wound for healing. If a sutured wound becomes infected *all* the sutures should be removed and it should be laid wide open. If an abscess is incised it should be opened with a wide incision. Undermined edges and pockets should be viewed with suspicion and eliminated whenever possible. If the skin grows across before these areas are entirely filled with granulations, there is danger of the formation of residual abscesses which harbor infection and continually discharge pus through sinus tracts. These usually persist until they are laid wide open by a secondary operation.

FOREIGN BODIES

Any foreign body in an infected wound acts as an irritant and, if not removed, becomes a cause of continuous purulent discharge. As healing progresses a sinus

tract will form connecting it with the outside. It is important, then, that all foreign bodies be removed as soon as possible. These may find their way into a wound at the time of its infliction. Buried, unabsorbable sutures act as foreign bodies in the event of infection. Furthermore, dead tissue often sets up a similar reaction. Its careful removal expedites healing.

DRAINS AND PACKING

In certain types of wounds, for one reason or another, it may be undesirable or impossible to achieve the ideal shape for free drainage and healing. A wound may be very deep and narrow, or it may be on the face or neck where free opening is undesirable. Under these conditions it is important to allow free exit for the purulent exudate until such time as the depths become filled with granulation tissue. This can be accomplished by the judicious use of drains and packing.

A drain establishes a tract along which the exudate finds its way to the outside. Rubber dam or small rubber tubing provides the best material. It is rarely necessary to drain a minor wound for more than forty-eight hours. Care should be taken not to leave a drain in too long. It tends to create a foreign body reaction within the wound with a consequent increased exudate. The inexperienced observer may consider this as added evidence of the value of the drain and thus leave it in until a permanent sinus is formed. If the tract to be drained is long it is advisable to shorten the drain by degrees at consecutive dressings. This will tend to allow the tract to heal to the tip of the drain each day, thus obviating the danger of the formation of a residual abscess.

Packing can be used to improve the shape of a wound. It will keep the skin edges apart until the pockets beneath are obliterated. It will keep undermined areas open until they fill in from their depths. As in the case of drains, packing is rarely necessary after the first forty-eight hours. If not used judiciously it may act as a plug and thus defeat its own end.

The indiscriminate use of drains and packing is to be avoided. They should not be introduced unless the surgeon hopes to gain a definite purpose thereby. The very fact that there is an open wound does not mean that it has to have something put into it.

ADHESIVE STRAPPING

If all is well with a wound and if it is rapidly filling with healthy granulations, there may come a time when healing can be expedited by drawing its edges together with strips of flamed adhesive. This procedure will lessen its size and therefore decrease the amount of work to be done by the healing process in filling and covering it. If this procedure is adopted care should be taken not to create pockets thereby. It is also important not to put the adhesive strips so close together that there is interference with free drainage.

Secondary suture of this type of wound should never be employed. The passage of the suture through the wall of granulation tissue makes infection of the surrounding tissues almost inevitable. All the advantages of secondary suture are obtained with flamed adhesive, with none of the dangers.

SUMMARY

1. If a wound becomes infected, all thought of primary union should be abandoned.

2. When a wound heals by second intention it heals from the bottom up.

3. Asepsis is necessary in the treatment of open infected wounds until they become impervious to infection.

4. Comfort, cleanliness and protection are important considerations.

5. Care should be taken that there is free drainage at all times and that the wound heals from the bottom before the epithelium grows across the top. Drains and packing may be necessary to achieve this end.

MICHEL CLIPS IN SKIN COAPTATION

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MICHEL metal clips are used for the coaptation of the skin in incisions and lacerations. If the parts are

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

under tension they should not be used except the tension is relieved by interrupted stay-sutures. The author has used Justrite Michel clips for nearly thirty years, especially in the skin coaptation of abdominal wounds in gynecological surgery.

The use of some kind of wound clip dates back many centuries. The Romans used clips, many of which were of fancy design. The first physician to employ them in Europe was the Swiss surgeon, Walter Ryff (1536). The "fibula chirurgica" has been referred to as a form of clip. Celsus, however, has listed a different explanation in his Latin surgical nomenclature. With many it is a debatable point. The Somali use acacia thorns in the suturing of wounds, a rather primitive antecessor to the skin clip. Other African Negroes make use of the thorns of the "mimosa," the gum arabic tree. Ants have been used in bringing cut skin edges together. This is mentioned in the ancient Indian textbook, "Ayurvenda," written by the Indian physician, Susruta, who lived in the time of Galenus. We read, "In order to close wounds efficiently, and in order to have them heal faster, one should resort to red ants who should be made to bite into the two wound margins in such manner that their mandibular forceps draw the wound margins together; then the bodies should be severed from the heads."

Justrite Michel clips may be procured in four sizes: small, medium, large, and very large. In small wounds, and especially those about the head and neck, the small size is preferable. We find the medium or large size ideal in skin coaptation of abdominal wounds, although there are some who use the very large size and depend on personal preference, the result of experience.

The accompanying illustrations give the exact sizes of Justrite clips, and, also, how they are supplied on wire holders.

Clips are for skin closure or coaptation only. If the wound is a deep one, or tension on the wound will be exerted until healing is completed, one must not rely only on clips to hold the wound together. Clips take the place of various suture material in the continuous, subcuticular, or interrupted closure of the skin in wounds—that and nothing more should be expected of them.

Some of the advantages of clips in skin coaptation are:

1. They may be applied with less pain than is necessary in the taking of stitches. This is a distinct advantage in skin closure in individuals who are conscious, especially if their pain threshold is low, and in children.

2. They do not penetrate and tunnel the skin, thereby providing avenues for infection.

3. They cause no discomfort to the patient while in use.

4. They are easily and quickly applied, and painlessly removed.

5. Invariably the wounds if uninfected, following the proper application of clips,

are excellent. Although the cosmetic result is not important in covered scars, as on the abdomen, on exposed parts of the body, such as the face, neck, and arms the cosmetic result plays a large part in the patient's eyes.

There is an art in applying clips in skin coaptation. Before applying the clips all bleeding points in the wound must be stopped. Of course, this is a primary rule in all wound closure. Then, an Allis clamp or a hook is placed in the upper and lower angle of the wound, and the wound is slightly stretched lengthwise. This brings the skin edges into apposition. It is most important that the skin edges meet on the same level. If the edges are inverted or one edge higher than the other an unsightly scar will result.

Clip-holders or smooth edged anatomical forceps may be used to hold the clip. The operator or an assistant holds the skin edges together with a toothed forceps. If the wound is short and the skin edges approximated sometimes this is unnecessary. The clip in its holder is then placed over the skin and bent until the skin edges are coaptated. Care must be exercised not to close the clips too tightly. It is better to have them a trifle too loose than pressed together too tightly, thus burying the clip in the tissues. Clips are spaced apart from 0.5 to 1.5 cm., depending on the wound and its site. A good rule to follow is to place a clip where you would an interrupted suture.

Clips are removed in two to five days. Small clips used about the neck and face may be removed in two to three days. In abdominal wounds and wounds of the back and extremities they had better be left in situ for five days. Some men never leave a clip in longer than three days no matter where the wound may be. If they are left in longer than five days local areas of skin necrosis and infection may result.

Clips are removed by straightening them out, or cutting the top of the loop with a special small scissors. There are clip-removers and scissors for these purposes. But should one not wish to use them, or does not have them at hand, he can remove the clips with two sharp pointed artery

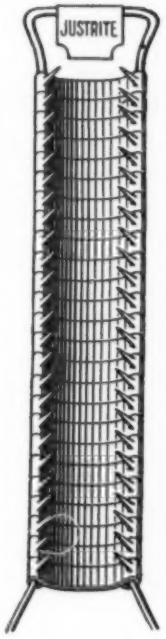

Fig. 5.

clamps. The base of the clip on one side is held firmly with one clamp. The other clamp is slipped under the bend at the top of the clip and held firmly. The clip is twisted in a straight line and removed.

For a few days clip-marks are present on the skin, but these soon fade out. Usually a month or six weeks after removal no traces of clip-marks can be seen. The scar is a hair line that will become invisible with time provided infection has not occurred, or a keloid has not formed.

The method of skin closure is mainly a matter of habit with most men. As a result of early training some continue to use needle and suturing material; others find clips ideal for emergency and office work. The writer, in thousands of patients has found their use in skin coaptation in abdominal wounds so satisfactory that he has no idea of changing to any other method or material.

SUMMARY

Justrite Michel clips are ideal for skin coaptation. They come in four sizes, from

small to very large. The medium or large size is preferable in abdominal, back, and extremity wounds; the small size is used in wounds about the head and neck. Care must be exercised to have the skin edges approximate on the same level, and the clips must not be clamped too tightly. They are removed in two to five days. In the absence of infection or keloid formation, if the wound edges are carefully coaptated and sealed with clips the resulting scars are uniformly satisfactory. The use of clips has many advantages in minor surgery and office work.

BEDSORES (DECUBITUS)*

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BEDSORES, cuticular necrosis, decubitus and skin ulcers are synonyms describing an annoying condition which affects mostly bedridden patients. The areas most frequently involved are those exposed to pressure, over the sacrum, the trochanters, the scapula, the spinous processes of the vertebra, the external malleoli and the heels and the internal condyles of the humerus (Figs. 1 and 2). In highly susceptible tissues bedsores may appear upon any portion of the body, such as those produced by the mere weight of bed clothes; a hand lying on the abdomen; or the mere resting of one cutaneous surface against another as may occur about the vulva or scrotum. In cases of extreme emaciation certain bones, especially the anterior superior spinous processes of the ilium, may protrude through the overstretched and atrophic skin even without the added aid of external pressure.

Bedsores are most commonly the result of long continued pressure between the bed and some more or less superficial bone; this is augmented by the absence of the normal protection of the elastic layer of fat. Contributory causes are feeble circulation on the most dependent portions of the body; lack of tissue resistance as a result of disease; alterations in the intima of the blood vessels due to bacterial poison; lack of nutrition from capillary stasis; changes in the blood, etc.

Tinna pointed out that evaporation of fluids from the tissues which takes place in the presence of anemia is a contributing factor in the genesis of decubitus.

Fantus ascribes the appearance of bedsores to two factors, extrinsic and intrinsic. Among the extrinsic causes may be mentioned prolonged pressure, maceration and traumatism and those resulting from intrinsic causes are lowered tissue vitality.

Bedsores are most frequently encountered in severe and prolonged fevers, accompanied by emaciation and prostration in such exhausting diseases as typhoid fever and osteomyelitis, for example. The condition also occurs in diabetes and Bright's disease, following operations on the aged, prolonged confinement to bed after Kraske operations and in certain lesions of the central nervous system, especially those complicated by paralysis. Constant soiling of parts with persistent discharges of feces and urine, wrinkles in the bed clothes, crumbs, maceration from perspiration, injury from rough handling, pressure from splints, casts, hot water bottles, tight bandages, etc., may also give rise to bedsores. Occasionally decubitus will develop following the use of local anesthesia. Severe injuries of the spinal cord or peripheral nerves are extremely liable to be complicated by a sudden appearance of extensive and troublesome bedsores.

The principal types of bedsores usually observed are the ordinary decubitus; and that appearing in connection with nervous lesions. Decubitus as the result of lesions of the nervous system differ from the ordinary form in no way except in their rapidity of extension and destructiveness.

PATHOLOGY

Both varieties of bedsores probably originate in thrombosis of the smaller vessels; this gives rise to gangrene, sloughing and ulceration, extending more or less rapidly and extensively according to the resisting power of the tissues. Sometimes the causative infection is of a virulent type of streptococcus which produces necrosis;

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or, anaerobic organisms in the area of the sacrum may be responsible for the condition. In such cases the process spreads rapidly and is characterized by a progressive gangrenous border.

Fig. 1. Decubitus of left buttock; automobile accident resulting in fracture of right side of sacrum, fracture of superior and inferior rami of each pubic bone, separation of left sacroiliac articulation. Due to injury of the bladder patient was unable to void, necessitating use of retention catheter. Patient developed cystitis, pyelitis and hematuria. Urine was dribbling constantly into the bed. Because of the necessity of maintaining the fractures in good position, it was difficult to turn the patient. With the healing of the fractures the patient was turned on her abdomen.

Fig. 2. J. V., aged twenty-six years; bedsore over sacrum complicating acute gonorrheal arthritis (multiple). Slightest movement caused excruciating pain.

Charcot and others have attempted to explain the peculiarities of bedsores following lesions of the nervous system by assuming the existence of certain trophic centers governing nutrition, damage to which results in neuronecrosis when aided by local pressure. However, such trophic centers have never been demonstrated with certainty.

Trumble suggests two factors in the production of bedsores, intensity and duration. He states that the skin is capable of withstanding very high pressure for a short period of time or even for a great number of short periods, if there are intervals of freedom from excessive strain. Bedsores, according to Trumble, are produced as a rule, by quite moderate pressure acting continuously over a long period of time.

SYMPTOMS

The first thing noted in the development of bedsores is a dusky-red discoloration, due to passive hyperemia of the skin. This is followed by a purplish tinge, gradually changing to black as gangrene results. Infection soon takes place, followed by inflammation and ulceration. Exudation and pus appear and the surrounding tissues become red and swollen. Gangrenous sloughs separate, exposing a ragged unhealthy ulcer. This usually extends in all directions often causing marked loss of

tissue substance. The underlying bone frequently becomes exposed and may erode into the spinal canal itself (in decubitus over the sacrum). Death may occur from exhaustion, sepsis, pyemia or spinal meningitis. If healing occurs, disfiguring cicatrices may form, in some cases interfering with locomotion.

Ordinary decubitus is usually slow in formation but the form due to nerve lesions appear rapidly, with the production of large sores in relatively short periods of time; such bedsores cause no pain by reason of the existing cutaneous anesthesia. In ordinary bedsores pain is intense, especially after ulceration appears. Healing is slow, sometimes not occurring until the disease which caused it has subsided; or the injury to the nervous system remedied.

TREATMENT

Prophylactic. The backs of all very sick patients should be examined daily. Whenever the possibility of decubitus exists, suggested by cutaneous erythema disappearing on pressure, is present, the skin of vulnerable parts particularly should be kept clean, dry and free from pressure. Once or twice daily, parts soiled with urine and feces should be washed with soap and water. Care should be taken not to injure tender surfaces. The skin should be thoroughly dried and dusted with borated talcum powder, zinc stearate powder or anointed with salve, ore lastic adhesive should be used. Bed sheets should be changed often to prevent decomposition of perspiration and should be kept tightly stretched across the bed by pinning them to the mattress. Maceration of the skin from sweat, urine, fecal matter or pus should be prevented by the free use of absorbent material with a foundation of several thicknesses of newspaper.

Frequent change of position prevents bed sores. Nurses should be instructed to report where the patient shows disinclination to change posture. This should be remedied.

To improve the circulation of the tissues of the back, the back rub is the most important aid. Alternate hot and cold applications also help to improve circulation. If the skin is soft it should be hardened with 5 per cent silver nitrate or a saturated solution of alum in diluted alcohol; or spirits of camphor; or vinegar, lemon juice or salt, one dram to each pint of alcohol. If the skin is dry a piece of moleskin adhesive plaster or a dressing of flexible collodion may keep a harsh, dry skin from cracking. After each cleansing a little hydrous wool fat should be rubbed in or the following prescription, suggested by Fantus, used:

℞ Zinc stearate..... 5.0
Tincture of benzoin..... 5.0
Scarlet Red ointment 5 per cent..... 0.25
Hydrous wool fat..... 30.0
Liniment of camphor..... 180.0
Mutton tallow..... 500.0
Sig. Melt the fats, add camphor liniment; when mixture is almost cooled, beat in tincture of benzoin and zinc stearate until a creamy mixture is secured.

Pressure should be relieved with pneumatic rubber rings covered with cloth or by rings made from rolls of cotton which are placed beneath the pelvis and the heels. In fractures of the spine, put the patient on a pneumatic or water bed. Do not use pads of cotton beneath the vulnerable areas.

When lesions of the nervous system exist, bedsores usually appear sooner or later in spite of the most careful attention. If hemiplegia exists the paralyzed parts should be protected by the patient lying upon the sound side as much as possible.

If, in spite of all precautions a bedsore seems inevitable, which is evident by the fact that pressure no longer drives redness from the congested part, strict prophylaxis should be reinforced by the addition of tannic acid and dry heat treatment lauded by Latimer, which consists of a 5 per cent aqueous tannic acid solution neutralized to the *p*H of the blood by Seeger's method; this is sprayed on the vulnerable parts every hour. Between treatments the parts are exposed to dry heat from electric lights, an electric hair dryer or an infra-

red burner. Research work recently completed by Fantus has established a 10 per cent tannic acid in Ringer's solution as the most efficient form of tannic acid available. An additional application of 10 per cent silver nitrate further improves the results.

Active Treatment. The treatment of the bedsore per se is best accomplished by one of the following regimes: (1) tannic acid and dry heat (Latimer); (2) elastic adhesive plaster treatment (Carty); (3) insulin with or without parathyocresol (Powers).

Tannic Acid and Heat Treatment. Five per cent aqueous tannic acid alluded to above is sprayed on the parts every hour. Treatment is continued until a heavy coagulum is formed, which usually takes place in twenty-four to forty-eight hours. No dressings are applied after the coagulum appears, nor is sterile gauze used to keep the coagulum clean and dry. Healing occurs as in burns and as the coagulum separates at the edge it is clipped away. If infection complicates a bedsore, treat it with wet compresses of hydrogen peroxide, mild solutions of boric acid or Dakin's solution. When the infection subsides resort to the tannic acid and heat treatment. If infection occurs under the coagulum, this must be softened with sterile petrolatum and removed. The infection is then treated as previously outlined. When controlled, the tannic acid and heat treatment are resumed. Occasionally it is necessary to remove the coagulum several times because of infection. Each time the crust is removed the wound will be found to have decreased in size. A virulent infection, profound necrosis of tissue and bone involvement are contraindications to the tannic acid treatment.

Elastic Adhesive Plaster Treatment. Two pieces of elastic adhesive plaster, one over the other are applied, so that the bedsores and the skin surrounding it for at least an inch is covered. If the sore has a greater diameter than the elastoplast, two pieces may be laid side by side and held together by two pieces placed at right angles. It is left in position as long as it will adhere, usually twelve to forty-eight hours. This is repeated until healing is complete. On removal of the bandage no attempt should be made to clean the surface of the ulcer. Wipe away the discharge from the surrounding skin and reapply the adhesive. Cardy rationalizes his treatment as follows: (a) the discharge does not readily soak through; (b) the two layers plus the discharge over the ulcer serve as an effective cushion protecting the granulations by distributing pressure; (c) where incontinence of urine or feces is present the ulcerated surface is less readily contaminated. Usually the patient complains of itching under the bandage and much attention is required to keep the patient from scratching the bandage off. However, it is never so pronounced as to demand discontinuance of treatment.

Insulin and Parathyocresol Treatment. Five units of insulin are given three times daily before meals. Sterile gauze saturated with parathyocresol in 1:10,000 solution is applied directly to the bed of the ulcer, tucked in under overhanging edges and saturated three times daily. At the end of forty-eight hours, normal saline solution is substituted for the parathyocresol. This alternation is continued at intervals of two days until the patient is discharged. The trade name for parathyocresol is sulphen.

Adjunct treatment consists of clipping away sloughs and opening and draining pus pockets. In extremely bad sores accompanied by much suffering, arrange a continuous bath, which is kept clean by continuous overflow and refilling and at a constant temperature, controlled by a thermostat. Perfect drainage and relief from pressure are thus augmented.

Other forms of treatment which have been suggested are: For surface stimulation:

Argent. nitric	1.0
Balsam of Peru	10.0
Ung. Zinc Oxide qs. ad.	100.0

To produce a dry gangrene, use thymol iodide-ferrous sulphate as a dusting powder.

SUMMARY

A brief resume is given of the various types of bedsores and their etiology, pathology and symptoms are discussed.

Three definite plans of treatment are described, namely: (1) tannic acid and heat treatment; (2) elastic adhesive plaster treatment; and (3) insulin and parathyocresol treatment.

REFERENCES

Brynes, C. M. *Jour. Neurol. and Ment. Dis.*, 82: 373–380 (Oct.) 1935.

Carty, I. J. A. Treatment with elastic plaster. *Brit. Med. Jour.*, 1: 105–106 (Jan. 19) 1935.

Fantus, B. Therapy of the Cook County Hospital. *J. A. M. A.*, 104: 46–48 (Jan. 5) 1935.

Keen's Surgery. Philadelphia, W. B. Saunders & Co., 1909, Vol. 1, pp. 333–338.

Latimer, E. O. Treatment with tannic acid. *J. A. M. A.* 102: 751–752 (March 10) 1934.

Nelson's Loose Leaf Living Surgery. Thomas Nelson & Son, 1927, Vol. 1.

Powers, J. H. Insulin and thyocresol. *Clinical Misc. Mary I. Bassett Hospital*, 2: 45–52, 1935.

Trumble, H. C. Skin tolerance for pressure and pressure sores. *Med. Jour. Australia*, 2: 724–726 (Nov. 29) 1930.

GAS GANGRENE

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SURGEONS and medical men in general have become "anaerobe minded" since the World War. It was during this time that gas gangrene infections were first frequently encountered. The severity of the symptoms asociated with such a high mortality and morbidity stimulated a rather concentrated study of the condition by clinician, bacteriologist and surgeon alike. Many questions have been answered and many still remain unanswered, however, we now have at least a logical attack to the problem and therapy has become quite standardized. This in itself is a tremendous stride forward and it behooves us to be abreast with the knowledge acquired especially in the last decade or two.

BACTERIOLOGY

Originally gas gangrene infections were thought to be due to one specific organism, namely Bacillus aerogenes capsulatus of Welch but Weinberg and Seguin demonstrated that this concept was erroneous. They stated that there are many other anaerobes which include Bacillus edematiens or vibrion septique of Pasteur, oedematiens novyi, Bacillus histolyticus of Weinberg and Seguin, Vincent's bacillus, fusiforms, etc., which are capable of producing the same disease. The part played by Bacillus coli and anaerobic cocci seems to be that of a forerunner in that they prepare the tissues for the development of the disease. This is still a mooted question.

In daily practice we must have some simple concept of the bacteriology which confronts us, hence, we may simplify matters by stating that only five of the anaerobic bacilli are of importance to the surgeon, four of which belong to the gas gangrene group and the remaining one being the tetanus bacillus. Each produces a powerful exotoxin which may be neutralized by proper anti-sera. All five are Gram positive bacilli and practically all of them are spore formers, therefore, they have been given the generic term "Clostridia" by the nomenclature committee of the Society of American Bacteriologists. We may discuss the five as follows

A. Clostridium Welchii. This is the commonest and most important variety. It is universally present in the intestinal tract of man and most animals, just as is Bacillus coli, but since it has the ability to form spores it may survive for a long period of time outside of the body in such habitats as fertilized soil and street dirt. The filth of trench life and contamination of gunshot wounds with soil and clothing explains its frequency during the last war. If found in a wound with no signs of activity, we consider it a saprophyte. This may become pathological only when large numbers are introduced and foreign bodies are present in an environment where considerable tissue destruction exists, especially muscle.

B. Clostridium novyi,

C. Clostridium oedematis maligni,

D. Clostridium sordelli.

These three listed organisms may be considered and discussed together. Clinically, it is quite important that these anaerobes be differentiated from C. Welchii and from one another. Such differentiations may be made by noting their cultural characteristics and response to specific antitoxins. They are all gas formers with resultant gangrene and may be found with C. Welchii in a given wound, but in the absence of the latter the involved area is more edematous and less gaseous. Isolation

and cultivation from the blood stream is possible only preterminally or after death.

E. Clostridium Tetani. The distribution of this anaerobe is similar to that of the gas gangrene organisms being found less often in the human intestinal tract than C. Welchii but being quite common among persons in contact with horses and cattle. Wounds which have been exposed to fertilized soil, street dirt and the like must therefore be suspected of possible contamination with C. tetani and its associated bacteria. Unlike the gas gangrene organisms it does not invade the body but remains in its site of entrance and there produces a toxin which has a definite affinity for nerve tissue. This has its clinical significance and we will refer to it in the discussion of treatment.

PATHOLOGICAL PHYSIOLOGY

The course of events that follows here is not constant, since such variables as the patient's resistance, the virulence of the organisms, blood supply, amount of muscle destroyed and the presence of foreign bodies all tend to modify the cases as seen. However, an understanding of this perverted physiology will help to clarify and explain many objective and subjective findings which we may encounter.

The spread of the disease is chiefly in the muscles rather than the fascial planes. Secondary foci of infection are at times found, their avenues of extension usually being the lymph streams. Generalized blood stream infections and involvement of serous surfaces have been recorded.

The production of gas is explained by the fact that the glycogen of living muscle is converted after death into dextrose and isomaltose (Henry), which are fermented by B. aerogenes capsulatus and allied organisms. The gas itself is non-toxic but due to its pressure an occlusion of the surrounding vessels is produced with a resulting ischemia. The toxins formed damage the adjacent blood vessels causing additional thrombosis and rupture. The muscle cells become soft and mushy and a color alteration takes place. When ecchymosis is the predominating factor the muscle bundles assume a dark brownish-red color, but when necrosis predominates the color assumes its typical brick red or salmon appearance. The body apparently has difficulty in mobilizing its usual forces of resistance. This is borne out by the lack of leucocytosis and the absence of leucocytic infiltration. In its place we usually find an extensive serous exudation with a marked edema far out of proportion to the degree of infection. Spread is rapid, putrid abscesses with their characteristic brownish fluid and sickening odor appear and finally the toxins gain access to the blood stream causing a rapid exitus by paralysis of the medullary centers.

HISTORY

The anamnesis usually reveals the source of contact with the organisms. Injuries which occur in streets and around filth associated with foreign bodies, clothing, missiles, etc., must always be regarded as potential gas gangrene infections especially if the wound penetrates deep and involves the musculature. The condition may make its appearance following surgery if it is immediate and following an amputation of a diabetic or arteriosclerotic extremity or it may be delayed and following some simple plastic operation. The latter two instances again emphasize the part played by traumatized tissue and impress us with the fact that no typical sequence is a necessary prerequisite.

The initial symptom is usually pain or an increase in the intensity of a preexisting pain occurring eighteen to twenty-four hours after the injury. The picture from this point on follows a rather stereotyped pattern.

Physical examination reveals an exceedingly sick patient showing signs of marked prostration, restlessness and apprehension. The expected malar flush seen with most pyogenic infections is replaced by a striking

pallor. The temperature rises and may reach a height of 103 to 105 degrees. The pulse rate quickly ascends and in the early stages the tachycardia far exceeds the rising temperature. The amplitude of the pulse becomes steadily smaller with a corresponding drop in blood pressure. Circulatory collapse may be so marked that an internal hemorrhage is at first suspected. At first blush the clinical picture seems to be out of proportion to the local injury.

Inspection of the wound reveals discoloration but not the typical picture of an acute inflammation. The redness is dusky rather than scarlet and the surface temperature shows no apparent increase, in fact we are quite surprised to find that the limb, distal to the involved area, becomes progressively cooler as its circulation becomes impeded. As the edema spreads the overlying skin becomes blanched and raised vesicles appear and, if infected, inspection reveals frank gangrene with sloughing necrotic tissue. If gentle pressure is exerted on the margins of the wound, a sanguinopurulent exudate containing gas bubbles makes its appearance. The discharge usually has a foul odor suggestive of putrescent meat. Early in the course of these infections it is difficult to detect the presence of gas, however, the best means of determining its early presence is by auscutlatory percussion. Gas in any appreciable amount transmits a sensation of crepitation to the palpating hand which cannot be mistaken. An *x*-ray film will frequently demonstrate gas in the tissues even before auscultation or palpation. The rapidity with which these changes occur and the associated high mortality, makes early diagnosis and immediate treatment imperative.

TREATMENT

If we could constantly keep in mind the difference between a soiled and an infected wound the incidence of gas gangrene could be reduced to a minimum. The differential diagnosis of these two lesions is at times simple if we consider such factors as: the environment in which an accident occurred, amount of gross soiling in the wound, duration of a recent injury or pre-existing disease, blood supply and finally the condition of the soft tissues especially muscles, as to its color, contractibility and ability to bleed. Once the condition has started there is but one treatment and that is surgical. This may be in the form of massive debridement associated with multiple incision extending into normal tissue or, in advanced cases, immediate, high amputation. The use of a tourniquet is to be discarded. The resulting wounds, be they linear incisions or a guillotine amputation stump, should be left wide open to permit the entrance of oxygen and to encourage the drainage of any noxious exudate. They should be frequently irrigated with 50 per cent peroxide and then loosely packed with 1 per cent potassium permanganate. These dressings should be changed often and kept saturated.

Serum prophylaxis and serotherapy is at present accepted. Ivens believes that the polyvalent sera have definite prophylactic value. The prophylactic dose of gas gangrene antitoxin in conjunction with tetanus antitoxins is now available. It contains 15 units of tetanus antitoxin, 10 units of perfringens antitoxin and 10 units of vibrion antitoxin. In the active serotherapy we use a polyvalent serum containing 4000 units of tetanus antitoxin, 15,000 units of perfringens antitoxin, 35,000 M.L.D. of vibrion antitoxin and 20,000 M.L.D. of histolyticus antitoxin per 100 c.c. of saline; 200 c.c. is given immediately before or after operation followed in four hours by an additional 100 c.c. The marketed commercial products may be given intravenously or intramuscularly, preferably the former. To prevent anaphylactic reactions some authorities advise diluting the serum with 500 c.c. of normal saline and giving it subcutaneously. The amount to be used and the frequency of administration can only be determined by the patient's condition and his response to treatment. Although

at present the consensus of opinion is that these sera are of definite value, both prophylactically and therapeutically, it must be remembered that they by no means supplant surgery and are used only as adjuncts to the scalpel.

Ether and chloroform anesthesia should be avoided since they tend to produce an acidosis which favors the infection. If an amputation is decided upon, spinal is the anesthesia of choice, however, linear incisions may be accomplished with local infiltration or nitrous oxide inhalation.

General supportive measures and symptomatic treatment should be instituted in conjunction with the therapy as outlined. Finally, a constant vigilance should be kept for the development of a probable acidosis which must be immediately combatted by proper forms of alkalinization. Discussion concerning the utilization of charcoal, rivanol, Pilcher's solution, oxygen injection into the tissues and *x*-ray therapy has been intentionally avoided since their efficacy as therapeutic aids awaits further and more detailed reports.

SUMMARY

The outstanding highlights, when we consider the subject of gas gangrene, may be listed as follows:

1. An understanding of the bacteriology and its clinical application;
2. The picture of a patient whose critical general condition is out of proportion to his local lesion;
3. The differential diagnosis between a soiled and an infected wound;
4. The early demonstration of crepitus by either palpation, auscultatory percussion or *x*-ray;
5. The immediate institution of proper therapeutic measures.

REFERENCES

Bergey, D. H. Manuel of Determinative Bacteriology, Ed. 3. Baltimore, Williams & Wilkens Co., 1930.

Christopher, F. Textbook of Surgery. Philadelphia, W. B. Saunders Co., 1936.

Lewis, D. Practice of Surgery. Hagerstown, Md., W. F. Prior Co., 1933.

Milch, H. *Ann. Surg.*, 93: 1220 (June) 1931.

Miller, W. M. *Surg. Gynec. and Obst.*, 54: 232 (Feb.) 1932.

Weinberg and Seguin. La Gangrene Gazense. Paris, Masson et Cie, 1915.

BLOOD TRANSFUSION

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THE object of this paper is to discuss some of the more important practical problems associated with the procedure known as whole blood transfusion.

It is not necessary to enter into a discussion of the life-saving therapeutic value of properly matched whole blood as the literature on this for the past twelve years is very convincing.

SELECTING A DONOR

The first important step in a successful transfusion is the selection of a proper donor, and although this part of the procedure is better than it was ten years ago, many serious mistakes are still being made causing deaths and lawsuits.

The wrong way to select a donor is to use a friend or relative just because his blood matches with that of the patient's. Many recipients have been infected with syphilis by this procedure.

It is wrong to place the responsibility of the blood matching in the hands of internes unless they have had special training in this work.

It is wrong to use the so-called universal donors without doing a complete cross-matching. The right way to choose a donor is to do a Wassermann or Kahn blood test on him before the transfusion, and a physical examination. A short history is taken. Be sure to ask about tuberculosis, malaria and venereal diseases. Hemoglobin estimation should show at least 80 per cent.

BLOOD TYPING OR GROUPING

This is not necessary but is of value in saving time when sending for a professional donor.

Many errors are made in typing bloods due to the fact that diagnostic sera becomes inactive; this is the reason why so many people are placed in Group O. My own blood was typed three times before it was properly classified; the first time I was put in Group O when as a matter of fact I belonged in Group A.

It must also be remembered that although patient's and donor's blood belong to the same group, they may not match.

Every individual should know to what group his blood belongs as this often saves much valuable time and may save a life.

BLOOD GROUPS

International		Moss		Jansky
AB	same as	1	same as	4
A	same as	2	same as	2
B	same as	3	same as	3
O	same as	4	same as	1

The International classification is the one in common use.

BLOOD MATCHING

It is important that complete cross-matching of the bloods of the recipient and the donor should be done before selecting a donor for transfusion. No short cut methods should be employed and if there is any question about the reactions the test should be repeated.

One often hears that it is only necessary to mix the recipient's serum with a solution of the donor's cells and if no agglutination occurs they match. This is wrong and many serious reactions have occurred when this method was used.

PERFECT BLOOD MATCHING

This is one in which the recipient's serum and a 5 per cent normal saline solution of donor's cells are mixed together on a glass slide in sufficient quantity (0.5 c.c.) so that they will not dry out in one hour.

This slide is allowed to remain at room temperature for a period of thirty minutes; if no agglutination of the red cells occurs proceed to complete the cross-matching by repeating this test using another slide with a 5 per cent normal saline solution of recipient's cells and donor's serum. If there is no agglutination of the red cells on this slide the bloods match, and it is safe to use this donor. This test appears to be very simple but many errors are made, e.g.:

1. Drying out of the slides gives one the picture under the microscope of agglutination.
2. Do not put the slides in an incubator; it is not necessary and may cause the slide to dry out.
3. Do not put the slides in an ice box; it will hasten the reaction but may cause false agglutination.
4. Rouleaux formation of red cells is often taken for agglutination.
5. False agglutination is one in which the red cells group together but the cells remain intact. This can be determined under the high power lens of a microscope.
6. In large transfusions where two donors are going to be used in the same transfusion their bloods should be matched against one another in addition to matching them to the blood of the recipient.

Drying out of solutions can be prevented by the use of hanging drop slides. Also, much smaller amounts of solution can be used. Put a little vaseline around the rim of the depression in the hanging drop slide before putting on the cover glass containing the solution.

CLINICAL MATCHING

In an extreme emergency where a blood transfusion is needed at once, send for a donor whose blood belongs to Group 0 and his history and physical examination shows that there is no reason to believe he is suffering from tuberculosis, lues or malaria.

Inject 10 c.c. of his blood into a vein of the recipient and then wait two minutes; if no reaction occurs inject 20 c.c. of blood into the recipient and if after waiting two minutes no reaction occurs it is safe to proceed with the transfusion. If a reaction occurs discontinue the transfusion at once.

SYMPTOMS OF REACTION

Feeling of distress, dyspnea, chill, cyanosis, headache, pain in the back, precordial pain, convulsions and collapse; if anyone of these symptoms occur or a combination of them, it is called a reaction.

EXSANGUINATION-TRANSFUSION

This procedure is indicated in severe toxemia, e.g., following extensive third degree burns, uremia, carbon monoxide and metallic poisonings.

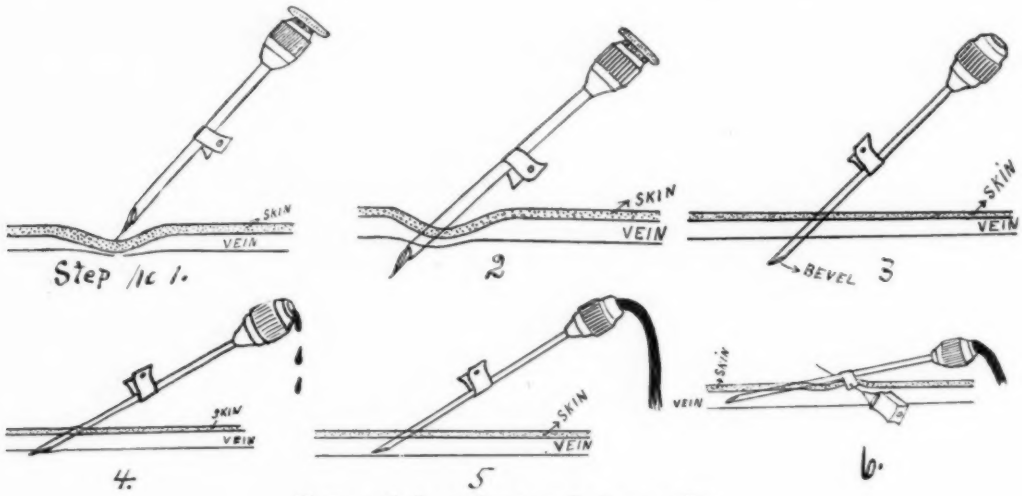
It is necessary to obtain a donor who can afford to lose 1000 c.c. of blood, or it is better to have at least two donors ready.

A No. 18 gauge needle is first inserted into the median vein of the donor and salt solution injected through this to remove any blood from its lumen. Under local anesthesia the saphenous vein just below Poupart's ligament is exposed and a No. 16 gauge cannula is inserted through this vein into the femoral vein; then, by means of the apparatus which will be described later, 1000 c.c. to 2000 c.c. of blood are removed. The amount taken will depend upon the reaction of the patient, as the blood is removed and the blood pressure of the recipient is lowered the first symptoms of danger as a rule are nausea and vomiting. When this occurs it is well to stop the exsanguination and begin the transfusion at once.

INSERTING NEEDLES OR CANNULAS INTO VEINS

One of the most troublesome and difficult parts of the technique in doing a blood transfusion is the inserting of the needles without cutting down on the vein. The reason for this difficulty is because we use comparatively large needles, and veins vary so much in size and in the thickness of their walls.

The needles we recommend and always use were devised by Dr. R. W. McNealey of Chicago. These needles can be locked to



Figs. 1–6. Inserting transfusion needles.

the skin and cannot pull out during the transfusion. No. 18 gauge is the size most commonly used. It is important to sharpen these needles before the transfusion and protect the points from injury while they are being sterilized.

The method I use to insert a blood transfusion needle follows:

After a tourniquet is placed around the arm a drop of 1 per cent procain is injected over the most prominent vein in the region of the elbow.

The vein is then stabilized by holding it between the left thumb and index finger and a No. 18 gauge McNealey needle is then pushed directly through the middle of the vein. It is very important that the needle pass through the middle of the vein; if not, the point will not slip into the lumen of the vein later when it is withdrawn. (Steps 1 and 2.)

Step 3. The needle is rotated around so that the bevel is now pointing down and the inner sharp cannula is now removed.

Step 4. Slowly withdraw the needle until blood begins to drop from the head of the needle; at this point the bevel is riding through the posterior wall of the vein.

Step 5. Very carefully and slowly withdraw the needle just a little more and you can feel the end of the needle snap into the lumen of the vein, blood will now flow freely from the head of the needle. The needle is then pushed well into the vein and connected to the apparatus.

Step 6. With a fine, 25 gauge hypodermic needle lock the needle to the skin.

Very Important. Always insert needle into the donor first. Failure to do this has caused deaths and serious infections to many innocent donors.

It does not make any difference which way the needle points in the donor, but it always should point towards the shoulder in the recipient.

FONTANEL PUNCTURE IN INFANTS

The practice of transfusing blood through the anterior fontanel should, in my opinion, be condemned, because one is not always certain that the needle passed through the fontanel will lie wholly within the sinus during the transfusion.

In infants, I always use either the median basilic or median cephalic vein and insert a small needle or cannula.

THE APPARATUS

A blood transfusion apparatus should be simple and accurate in construction and so designed that a physician unassisted can perform a transfusion successfully.

The operator should have absolute control of the flow of blood at all times, for that

reason any apparatus with automatic valves should be condemned.

All connections should be locked in such a way that it is impossible for them to come apart during the transfusion.

Fig. 7. The Scannell transfusion apparatus.

There are no sharp corners or dead spaces in the apparatus where blood can stagnate and clot.

SYRINGES

These are made especially for transfusions with a large opening at the tip and the pistons fit accurately and tightly. Before putting in the sterilizer lubricate the piston and inside of the cylinder with mineral oil or white vaseline and wrap each one separately in gauze or a towel. Enough of the vaseline will remain to lubricate the syringe.

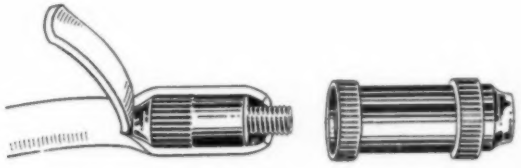


Fig. 8. Rubber tubing and metal connections locked together.

VALVE

This is a precision instrument and made with a great deal of care and accuracy and should be handled carefully. After every transfusion wash it with ether and lubricate it with a fine grade of light machine oil.

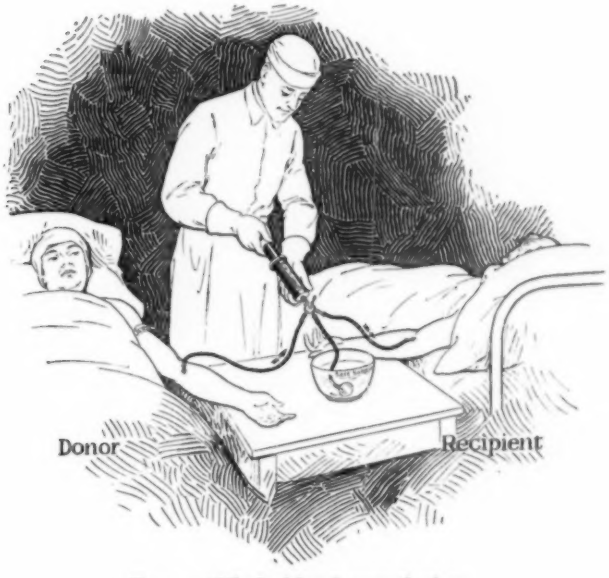


Fig. 9. Whole blood transfusion.

RUBBER TUBING

After trying many varieties including transparent tubing, I prefer to use a good grade No. 20 F. uretheral male catheter; the ends are cut off and locked in the following manner to metal connections:

TRANSFUSIONS

After inserting the needle in the vein of the donor, connect one of the side tubes coming from the valve to this needle. Loosen the tourniquet around his arm and draw up 10 c.c. of saline solution through the middle tube and inject this into the donor to determine if the point of this needle is resting wholly within the lumen of the vein. This procedure is again repeated after the needle or the cannula is inserted into the recipient.

Hold the syringe in the left hand in such a way that the valve handle can be turned readily with the left thumb and start the transfusion.

If the syringe fails to fill, the point of needle is not in the donor's vein or the tourniquet around his arm is too tight.

If at any time during the transfusion the piston begins to stick turn the valve-handle until the arrow points to the outlet to the basin of salt solution and wash the syringe out two or three times. Also wipe off the upper part of the piston with a piece of gauze wet with saline solution. At the conclusion of the transfusion wash and clean the apparatus at once; this is done by forcing plain water through the apparatus several times, then peroxide of hydrogen, plain water again, and finally ether.

Any one who expects to do blood transfusions successfully should not only own, but also take personal care of his apparatus.

CUTTING DOWN ON A VEIN

If this becomes necessary make a small transverse incision over the site of the vein. The vein is disected free and held out of the wound by two pieces of fine catgut or silk one above and one below. A *V*-shaped incision is made in the vein by means of a cataract scissors; a cannula is then inserted and tied into the vein by the upper piece of catgut.

TRANSFUSION OF CADAVER OR CONSERVED BLOODS

The reports from Moscow stating the success they have had using cadaver and conserved bloods in a transfusion have been received in this country with a great deal of interest. Without going into a discussion of this, which would be rather lengthy, it is evident that blood of this nature is much different than fresh live blood.

A review of the literature on this subject, some of which comes from Moscow, definitely concludes that the transfusion of fresh, whole blood is still the one of choice.

CONCLUSIONS

1. Fresh whole blood which is compatible has life-saving therapeutic value.
2. The prerequisites for donors are:
   - A. Freedom from syphilis, malaria and tuberculosis;
   - B. A red blood cell count of 4,000,000 and a hemoglobin of 80 per cent;
   - C. Complete and accurate cross-matching.
3. Successful blood transfusions are dependent upon:
   - A. Perfect instruments or apparatus;
   - B. Accurate knowledge of the technique in all its details;
   - C. Practice in its performance.

INTRAVENOUS INFUSIONS

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WATER loss and its replacement bring under one head a variety of disease entities, such as, diabetic ketosis, small intestinal fistulas, massive burn of the body and the postoperative surgical case. All of these conditions, although they have no clinical similarity, have water loss as a common characteristic. The cause of this loss is not the same in each condition nor is it the sole expression of the disease; yet, the dehydration imposes a great handicap upon the patient and its neglect becomes an important factor in the morbidity and frequently is a major contribution to the mortality in critical cases.

Normally, 65 per cent of the total body weight consists of water distributed in the blood, intercellular and intracellular fluid. Fluid loss from the body is a constant and normal process. This normal fluid loss through the various orifices and the skin is about two to four liters per day. This loss in the normal individual is replaced by the ingestion of fluids and food, the quantity being regulated by the sense of thirst and hunger.

In the normal individual an excess of fluid, either in the blood stream or in the tissues, is rapidly excreted through the lungs in respiration, through the kidneys as urine, through the skin by invisible evaporation and perspiration and through the intestinal tract. This regulatory mechanism of water balance is one of the normal physiological mechanisms of the body. In various pathological conditions this mechanism can be disturbed and fluid loss may become a major factor in the disease.

Some of the important surgical conditions in which fluid loss plays an important role and in which the normal regulatory mechanism may be upset are:

1. Hemorrhage;
2. Shock—it is generally accepted that in this condition there is a marked loss of fluid from the vascular bed and its transfer to the tissue spaces;
3. Loss of fluid from the gastrointestinal tract, vomiting or diarrhea;
4. Loss of fluid from the gastrointestinal tract in small intestinal fistulas;
5. Loss of fluid into the gastrointestinal tract, as is frequently seen in intestinal obstruction and ileus;
6. Hyperpyrexia and marked perspiration;
7. Metabolic disorders, as diabetic ketosis; and
8. Burns.

In most of these conditions the loss of water is accompanied by an equivalent salt loss and in those conditions in which food must be withheld, the depletion of carbohydrates leads to incomplete fat combustion with ultimate ketosis.

In the therapy of these conditions there are several factors to be considered.

1. The condition producing the fluid loss;
2. The state of the individual's organs, gastrointestinal tract, heart, kidneys, liver, etc., and
3. The elements requiring replacement water, salt, or carbohydrate.

Following hemorrhage an infusion of saline should be given to make up for fluid loss in the blood stream. Saline introduced in this manner does not remain in the blood stream for any extended period of time. It should be used only as a temporary measure until a donor can be typed and the patient given a transfusion.

For the normal postoperative surgical case, Coller, Dick and Maddock[1] recom-

mend 1000 to 3000 c.c. of dextrose in distilled water as an infusion to make up for fluid loss and to prevent thirst and ketosis.[1] They have shown that the daily administration of 3000 to 3500 c.c. of saline and glucose intravenously caused a gain in weight in 12 of 13 surgical patients studied. This gain they attribute to the retention of water in the tissues as a result of chloride retention. The administration of glucose and distilled water caused no gain in weight and when administered to patients after the use of saline, caused a rapid loss in weight. The observations of these authors are true and accurate and agree with similar experiments in the past. Their conclusions however, can be questioned. The two facts, (1) that distilled water is a dehydrating agent and (2) that salt retention and water retention go hand in hand have long been known. That edema and water retention due to salt retention can be released by distilled water and glucose, shows the qualities of distilled water as a dehydrating agent and the underlying mechanism by which it acts. But to conclude from this that the treatment of dehydration is by administering distilled water, e.g., a dehydrating agent, seems somewhat questionable.

It would appear that the best fluid to give the "normal surgical patient" who is dehydrated should be water which can be retained, e.g., saline. The carbohydrate is given to combat ketosis and the saline to make up the lost fluid and chlorides. If large quantities of fluids over long periods of time are required, one is no longer dealing with the "normal" postoperative surgical patient, in which case other factors would enter to govern the type of intravenous fluid required. The giving of intravenous saline in quantities of 3500 c.c. or more, daily, to a normal patient, with normal fluid losses of approximately 2000 c.c. daily, would of necessity, cause a salt and water retention.

In cases with severe vomiting or diarrhea, or with small intestinal fistulas or intestinal obstruction, the fluid loss can amount to 3000 c.c. per day. This loss must be made up; it consists not only of water but also of chlorides. These patients should receive 4000 to 6000 c.c. of 10 per cent dextrose in saline or Ringer's solution, the dextrose as a food and the saline and Ringer's solution to supply the lost chlorides. The administration of glucose in distilled water to these patients adds to the loss of chlorides, as the water is not excreted as H_2O, but as a dilute salt solution, thus increasing the chloride deficiency. Hartwell and Hoguet[2] have shown experimentally in dogs that where there is a marked loss of chlorides and fluids by vomiting, as in cases of high intestinal obstruction, these animals could be kept alive for a considerable period of time by the administration of sufficient quantities of saline solution intravenously. Particularly in those cases of intestinal fistulas where the lost salts, other than sodium, become a factor, Ringer's solution is used alternating with the saline infusion. In this way the salts of sodium, calcium and potassium are supplied.

Many authorities lay great stress upon the dangers of right heart failure due to massive infusions. In an individual with a good cardiac reserve the danger does not lie in the quantity of the fluid administered, but rather in the rate of introduction. The circulation can readily accomodate itself to 200 to 300 c.c. of fluid an hour. When glucose solutions are given it has been found that the high rates of flow raise the blood sugar above the kidney threshold and causes a glyosuria with its attendant water loss. Fantus[3] states that "a 10 per cent solution (of dextrose) can be introduced at the rate of 500 c.c. an hour before the sugar tolerance of the average individual is overcome, as evidenced by leakage of sugar in urine."

The nutritional requirements of the average patient is approximately 2000 calories per day. To supply this with intravenous glucose is rather difficult because 1000 c.c. of 10 per cent glucose solution contains but 100 grams of dextrose and one gram of dextrose yields about 4 calories, so

that 3000 c.c. of 10 per cent solution would yield only 1200 calories. If one depends entirely upon the parenteral fluids for the nutritional requirements of the individual the more concentrated solutions should be used, such as 25 per cent dextrose solution.

In subacute or chronic conditions, cases of hyperpyrexia, marked perspiration, burns, metabolic disorders, ketosis, diabetic and otherwise, where the gastrointestinal tract is intact, fluid can be taken by mouth or rectum in the form of weak salt solution. If however, these routes cannot be utilized or are inadequate, fluids must be administered by the parenteral route either subcutaneously, hypodermoclysis, or intravenously, phleboclysis.

Hypodermoclysis may be used to supply a limited need for a short period. Owing to its attendant discomfort, the uncertainity of its absorption, the dangers of infections and sloughing, particularly when dextrose is used, and its quantitative limitations when fluids must be administered for a prolonged period, hypodermoclysis is gradually giving way to phleboclysis or infusion. Infusions overcome most of these disadvantages. However, the use of phleboclysis has frequently been followed by severe reactions and for this reason many who would like to use the procedure hesitate to do so.

An analysis of the cause of these reactions, has shown that in the majority of instances they can be prevented by careful attention to details in the materials used and their preparation.[4]

The distilled water must always be freshly prepared and triple distilled in order to remove the pyrogenic substances and prevent their reappearance. Only C.P. anhydrous glucose and C.P. sodium chloride should be used. Great care must be exercised in the weighing and transmission of the powder to the solvent so that no foreign material is introduced. The weighing machine, containers and all materials coming in contact with the powders must be scrupulously clean.

The hydrogen ion concentration of the solution must be fixed. The hydrogen ion concentration of the blood is fairly constant at a *p*H 7.4. Williams and Swett[5] have shown that a 10 per cent glucose solution changes its *p*H from 6.20 to 5.17 by boiling for twenty minutes. They have also shown that a glucose solution standing in a container in the laboratory for twenty-four hours changes its *p*H from 6.60 to 5.15. They believe there is a definite relationship between the hydrogen ion concentration of the injected fluid and the post-infusion reaction.

The reactions caused by variations in the *p*H of the injected fluid can be prevented by:

1. Injecting the fluid into the blood slowly so that the blood will have time to neutralize the fluid introduced;
2. Adding a buffer solution to the fluid to be injected;
3. Using only fresh solutions whose *p*H is known; and
4. Using solutions placed while fresh into vacuum containers. So long as a vacuum is maintained and the fluid does not come in contact with the external air its hydrogen ion concentration does not change.

Any solution, distilled water, saline or glucose, that is in contact with the external air is constantly undergoing some changes; pyrogenic substances develop, *p*H values change or carbonic acid is absorbed from the air. Any one of these may produce reactions. Solutions kept in open containers must therefore be used only if fresh. All flasks must therefore be dated and discarded when they are one week old.

The glass used throughout the distillation and as permanent containers must be hard, such as pyrex. It must be an alkali-free glass and scrupulously clean from all foreign material. The filter paper used must be of the best type so that there are no loose fibres which might be transmitted into the filtrate. The fluid should be filtered three times. The gauze, so often used as stoppers, frequently causes the appearance of lint in the solutions. To prevent this, pure gum sheeting may be

used or an inverted beaker makes a very good cover.

Improper sterilization of the rubber tubing is probably one of the most frequent causes of reaction. New tubing may be used without having had the talcum coating washed away; the tubing may have been sterilized by boiling in a soda solution in which case some of the solution may remain on the inner side of the tubing; sediment in the bottom of the sterilizer may settle in the tubing; some forms of tubing contain sulphur which when precipitated clings to the inner side of the tubing; any of these substances if washed into the blood stream may cause a reaction. The best tubing to use is made of pure gum. Between cases the tubing must be carefully washed, thoroughly rinsed inside and out with triple distilled water, and then packed in gauze and sterilized in the autoclave.

The Sloane Hospital for Women recommends the following: (1) Soak all new tubing in soap and water for one hour, (2) wash well with soap and water, (3) wash in running water, (4) soak for six hours in 4 per cent solution of sodium hydroxide, (5) wash well in running water, (6) wash well in distilled water. Pack and sterilize in the autoclave.

Some authors seem to lay too much stress on the temperature of the injected fluid. The exact temperature of the fluid when it reaches the patient is difficult to state. Excessive heat may cause the liberation of fibrin thus causing a reaction. Excessive cold should not be allowed. The best temperature is about room temperature. If the fluid in the container is warm and it is allowed to flow through the needle slowly enough, it will automatically regulate the temperature. Some recommend the use of a hot water bottle or an electrical heating apparatus around the tubing but this is usually unnecessary.

In sterilizing dextrose solutions carmelization of the dextrose may take place if the heat is excessive or extended over too long a period. This causes the solution to become light yellow or brown. *Any dextrose solution that is not crystal clear should not be used.*

All flasks, tubing, needles, etc., used, either in transporting or administering the infusion should be carefully washed before each infusion. Any old blood either in the needle or in the tubing will cause a reaction. All parts should be boiled for five minutes in a 0.1 per cent sodium hydroxide solution, then soaked in distilled water to remove the hydroxide and following this, they should be washed in triple distilled water, then assembled and sterilized in the autoclave.

In order to prevent reactions from infusions, the proper approach for the sterilization, preparation of the materials, etc., require that a separate room be provided for this purpose only. The management of this room must be placed in the hands of competent and reliable nurses whose sole duty shall be the cleansing, preparation and sterilization of the various materials and tubing used for infusion. This is expensive and cannot be carried out in smaller institutions.

It seems that our present situation with regard to infusion solutions resembles the situation which existed when the hospitals used to prepare, chromicize and sterilize their own catgut. Uniformity of results were not obtained until commercial houses began the manufacture of catgut. They, with their expanded facilities, were able to produce a uniform sterile product at a moderate price. There seems to be no reason why the saline, glucose and other intravenous solutions used for phleboclysis should not be prepared in quantities and sold to the hospitals at a moderate cost. The various institutions could demand a stable product without pyrogenic substances, in hard glass containers, properly stoppered or sealed so as to maintain the vacuum. The tubing and needles could also be supplied in quantities. The expense of maintaining an infusion room and unit in the hospital would more than cover the cost of buying a commercial product.

DETAILS OF TECHNIQUE

In most institutions the giving of an infusion is regarded as menial work and is usually assigned to the junior interne whose knowledge of asepsis, surgical technique, etc., is limited. As a result of this faulty arrangement, breaks in technique occur which allow foreign proteins, air borne bacteria, etc., to be introduced thus causing infusion reactions. As a rule patients requiring infusions are sick enough to have the personal attention of a more experienced member of the interne staff.

The veins generally used are the median basilic or cephalic veins. A tourniquet of soft rubber tubing is applied above the elbow. This distends the veins in the antecubital fossa and makes them visible or palpable. This tubing should be applied with a slip knot so as to be readily untied (Fig. 1). The pressure of the tourniquet should not exceed the blood pressure and

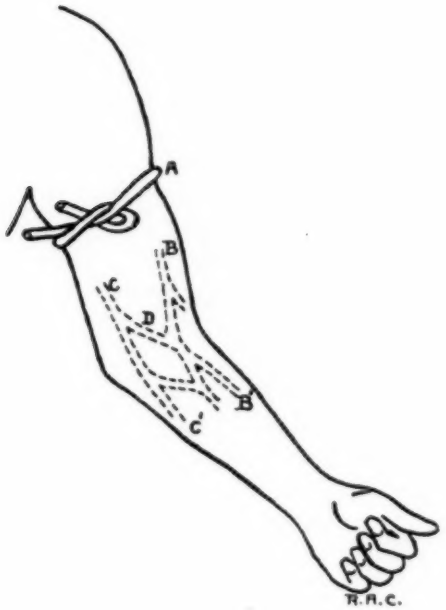

Fig. 1.

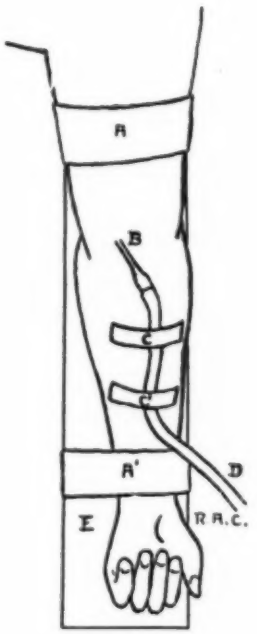

Fig. 2.

Fig. 1. Proper method of applying piece of rubber tubing as tourniquet to arm for purposes of distending veins at bend of elbow and usual distribution of superficial veins in antecubital fossa. Rubber tubing A is tied only sufficiently tightly about the arm to occlude venous return and not so tightly as to embarrass arterial blood supply. Note that the knot made by rubber tubing is in the nature of a slip-knot which can be released by simply pulling proper end of tubing; advantage of this is that release of tourniquet requires use of only one hand. Arm band of blood pressure apparatus makes an admirable tourniquet and presents especial advantage that pressure exerted by it can be controlled manometrically; accordingly, this device is offered merely as a substitute in case no blood pressure apparatus is readily available. Veins illustrated are B-B′ cephalic vein, C-C′ basilic vein, and D median cubital vein.

Fig. 2. Drawing illustrating technique of intravenous infusion. E is wooden board of suitable dimensions; it passes under back and shoulders of patient. A and A′ are strips of adhesive plaster or layers of bandage which fasten arm and forearm to board. B is infusion needle which has been inserted into one of the antecubital veins. C and C′ are strips of adhesive plaster which hold needle and rubber tubing D in permanent position. (Cutting, R. A. Principles of Preoperative and Postoperative Treatment. Paul B. Hoeber.)

one should always be able to feel the pulse at the wrist. Some men prefer to use a blood pressure cuff which allows the pressure to be regulated to that of the blood pressure of the patient.

The field should be draped with sterile towels and the region over the veins sterilized with iodine 3.5 per cent and washed with alcohol. The operator should wash his hands and don sterile gloves.

The vein should be palpated and a fine needle, preferably a 22 gauge, attached to a syringe should be introduced into the vein. As soon as the needle enters the cavity of the vein some blood should be drawn into the syringe. The needle should be introduced for about 1 cm. into the vein. The syringe is removed and the glass tipped cannula from the reservoir is attached to the needle. Before doing so however, it is essential to have all the air out of the tubing. This is done by raising and lowering the cannula with tubing attached allowing the saline to displace all the air in the tubing.

Continuous Infusion. Some patients may require 5000 c.c. of fluid daily for several days. This requires a continuous flow of fluid into the veins throughout the twenty-four hours, if the rate of 200 to 300 c.c. per hour is maintained. When this is required, the arm or leg should be securely tied to an arm board and the needle fixed in the vein. Most men prefer cutting down on the vein and inserting a cannula directly into it and tying it there for continuous infusion. Matas[6] advises a cannula with a terminal and lateral opening. In giving a continuous infusion, special care should be taken to maintain the sterility of the field, particularly when the vein is exposed by an incision.

CONCLUSIONS

1. Water loss, or dehydration is an important factor in the morbidity and frequently a major contribution to the mortality in critical cases.

2. To overcome dehydration, water should be administered as saline solution.

3. To prevent reactions, a good commercial product with proper equipment should be used and all aseptic precautions should be observed in its administration.

4. Patients sick enough to require an infusion should have the attention of an experienced member of the interne staff.

REFERENCES

1. Coller, F. A., Dick, V. S. and Maddock, W. G., Maintenance of normal water exchange with intravenous fluids. *J. A. M. A.*, 108: 1522, 1936.
2. Hartwell, J. A. and Hoquet, J. P. Experimental intestinal obstruction in dogs with especial reference to the cause of death and the treatment by large amounts of normal saline solution. *J. A. M. A.*, 59: 82, 1912.
3. Fantus, B. The prescribing of dextrose for phleboclysis. *J. A. M. A.* 102: 2165, 1934.
4. Falk, H. C. Common causes of reaction following use of intravenous solutions and their prevention. *New York State Jour. Med.*, 35: 480–484, 1935.
5. Williams, J. R. and Swett, M. Hydrogen ion concentration studies. *J. A. M. A.*, 78: 1024–1026, 1922.
6. Matas, R. The continued intravenous drip. *Ann. Surg.*, 74: 643, 1924.

ACUTE LYMPHANGITIS

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PHILADELPHIA

ACUTE lymphangitis, popularly known as blood poisoning, usually follows a trivial skin break, spreads with dramatic rapidity and has a mortality of from 20 to 30 per cent. It involves, simultaneously, the superficial lymph vessels and glands and might be better termed acute lymphangio-adenitis. It is also spoken of as acute spreading cellulitis or streptococcic septicemia. The high mortality will be raised or lowered in proportion as the physician first consulted, appreciates the necessity for complete immobilization of a member in which red skin lines extend from a peripheral wound to a palpable, tender lymph node.

ANATOMY

A knowledge of the anatomy of the lymphatic system will aid us in understanding the inflammatory reactions which occur when this circulatory body system is invaded by an infectious process. The lymph makes up one-sixth to one-third the weight of the entire body. It is a clear secretion resulting from the cellular activity of the tissues and every body cell may be considered as bathed in a sea of lymph. The lymph vessels emerge from the intracellular lymph spaces (Fig. 1) and constantly absorb whatever liquid is presented to them. These lymph vessels then run into and break up in the lymph glands. The glands detain foreign particles, bacteria, pathogenic cells, etc., and as far as possible destroy them. If the first lymph gland is unable to destroy infected matter some is carried to the next series of nodes which do what they can to complete the work. Thus the lymph nodes are the great system of defense in peripheral infection. If the bloc against spreading infection is successful, the invaded gland may resolve or break down into an abscess. If the bloc is unsuccessful, the infected matter enters the receptaculum chylae, passes through the thoracic duct into the subclavian vein and a general blood stream infection or septicemia results. Further filtering by the lymph glands of the infection in the blood stream may result in a general adenopathy. The lymph vessels also carry fluid from the serous cavities and chyle from the alimentary tract.

The subject of acute lymphangio-adenitis leads into so many byways in the broad field of infection, that perhaps it can best be approached in a practical, clinical manner by asking a series of questions and attempting to answer them in the way in which any one of us might do, when the patient with the sore finger and red streaks running up his arm walks into our office.

The questions would be about as follows:

1. What is the cause of lymphangio-adenitis?
2. In what types of wounds, occupations or systemic states is the more serious type of infection apt to occur?
3. What are the usual symptoms?
4. What symptoms may differentiate the mild from the serious case?
5. Are laboratory findings an aid to prognosis or treatment?
6. What lymph nodes are involved in infections of the different body areas?
7. With what other condition may lymphangio-adenitis be confused?
8. What sequels may be sought or anticipated?
9. What surgical principles are involved in the immediate treatment? Why? How are they clinically applied?
10. What is the treatment of the sequels?

The descriptions and clinical aspects are taken from 32 cases reported by Koch[1] and 16 personal unreported cases. The mortality in these 48 cases was 25 per cent.

1. *Cause of Lymphangio-adenitis.* It results from inoculation of a primary skin wound with some type of streptococcus (94 per cent) or staphylococcus (6 per cent). Other pyogenic organisms may enter into the picture; but the term "streptococcic septicemia" is not a misnomer. Hand infections usually result from a puncture wound by pin, needle, or wire, or an incised wound from a knife or other sharp metal edge. Foot infections occur from an infected blister, callus, or toe nail and head and face infections from a traumatized furuncle.

In 31 cases in which laboratory findings were available the following microorganisms were found: hemolytic streptococcus 20; non-hemolytic streptococcus 8; streptococcus viridius 1; hemolytic staphylococcus 1; staphylococcus aureus 1. The cultures were taken from secondary abscesses or from blisters or pus at the site of the primary wound. There were but three positive blood cultures in the 48 cases.

2. *In What Types of Wounds, Occupations, or Systemic States Are the More Serious Types of Infections Apt to Occur?* In the trivial, non-bleeding, punctured hand wounds of those whose occupations predispose to skin soiling with infected material. Expect trouble in the acute lymphangitis following the needle prick of the surgeon's finger, which occurs when he is working on a necrotic appendix, sloughing cancer or pelvic abscess; in the nurse who is scratched with the pin concealed in her patient's garments or bandages; in the pathologist whose skin is entered by a sliver of broken glass from a test tube or who nicks himself while doing an autopsy; in the butcher whose knife slips while cutting up the more or less dubious meat scraps for the day's supply of hamburgers; and of the facial pimple which flares up in a few hours following my lady's efforts to quickly rid herself of it by puncture and a hard squeeze. Hand infections are far and away the most frequent causes of serious acute lymphangio-adenitis and give the highest mortality; face infections come next; while foot, leg and peripelvic infections usually subside with nothing more serious than a localized gland abscess. It is worthy of note that in the 12 deaths in the 48 cases, 6 were in physicians and nurses. Spreading lymphangitis in the diabetic is always more extensive than in those with a normal blood sugar. But, strangely enough, it seems proportionately less fatal once the hyperglycemia is recognized and insulin is pushed, an argument in favor of those who advocate insulin in all extensive purulent conditions.

3. *What Are the Usual Symptoms?* When a skin lesion shows red wavy lines (tubular lymphangitis) running to the nearest lymph node, it means acute lymphangio-adenitis. It is the clinical stop signal to put the affected part and the patient at rest. A stinging, burning pain of the intermittant red hot needle type develops along the course of the lymph vessels and in the enlarged glands. As the process extends red lines appear from the glands first involved to the second set of tributary lymph nodes. In from six to twenty-four hours a spreading cellulitis (reticular lymphangitis) appears along the course of the lymph vessels and may spread to involve the whole member. The initial edema does not pit on finger pressure, as in thrombophlebitis. If the process is not arrested, localized abscesses may develop in the lymphnodes, or in the area of cellulitis, or the whole involved cellular tissue may undergo liquefaction necrosis. Fever and increased pulse rate accompany the local condition. A chill means that the lymph gland barriers have broken down, and that the invading organisms have entered the general circulation through the thoracic duct and subclavian vein.

Koch's[1] classification of end results, with the per cent in each class of the 48 cases, is as follows:

[1] Koch, S. L. Acute rapidly spreading infections of the hand. *Surg. Gynec. Obst.*, 59: 277 (Sept.) 1934.

a. Those in which the infection gradually subsides without destruction of tissue or abscess formation, 12+ per cent.

b. Those in which the infection subsides but late breaking down of lymph glands occur, 17+ per cent.

c. Those in which the cellulitis is rapid and diffuse, with final liquefaction necrosis and the formation of localized abscesses in the cellular tissue, or with extensive diffuse destruction of tissue, 44+ per cent.

d. Those in which the infection advances rapidly in spite of all efforts to check it and goes on to a fatal septicemia, 25 per cent.

4. *What Symptoms May Differentiate the Mild from the Serious Case?* The serious case is marked by an acute onset with rapid spread of local signs and early appearance of constitutional symptoms. The red skin lines appear in two to six hours following the primary wound. Secondary lymph lines streak up the member with dramatic rapidity. Lymphedema is coincident with the local lymphangitis. Systemic symptoms of chill, high fever, nervous stimulation and delirium occur in the first thirty-six hours. The case in which the initial lesion was probed, squeezed, incised or scraped is more apt to go on to a fatal bacteremia than the conservatively treated case.

5. *Are Laboratory Findings an Aid to Prognosis or Treatment?* No. The average leucocyte count in the non-fatal cases was 17,800, and in the fatal cases, 20,000, which does not hold with the accepted theory that a low leucocyte count means poor resistance. There was an average jump of 2500 when pus localization occurred in the non-fatal cases. But presence of the superficial abscess was always clinically obvious. The proportion of non-hemolytic streptococcus, hemolytic streptococcus and Staphylococcus aureus was about the same in the fatal as in the non-fatal cases. There were but three positive blood cultures, all hemolytic streptococcus, in the 48 cases. It would seem that the possibility of checking a fatal infection lies in the individual's general resistance, more than in the leucocyte activity or in the strain of the invading organism. Fatal cases were proportionately more numerous in those with indoor occupations.

6. *What Lymphnodes Are Involved in Infections of Different Body Areas?* These are graphically shown in Figures 2 and 3. Note that pediculi in children usually cause enlargement of the postoccipital and postauricular glands; that facial and upper lip lymphangitis is apt to be associated with thrombophlebitis; that infection of the ulnar side of the hand involves first the epitrochlear glands, but that the radial side gives primary axillary gland involvement; that infections on the palmar surface of the hand may extend through to the dorsal surface, but that dorsal infections do not spread to the palm; that dorsal infections of the fingers usually localize over the base of the metacarpals with the exception of the dorsal surface of the middle finger, where the lymphangitis runs directly to the clavicular glands; that foot and leg infections involve primarily the saphenous glands and that anal infections, a point often overlooked, involve the inguinal glands.

7. *With What Other Condition May Lymphangio-adenitis Be Confused?* With acute thrombophlebitis. The latter condition most frequently develops in the leg, next in the face and rarely in the arm. The differential diagnosis is graphically shown in Figure 4. Note that lymphangio-adenitis is always associated with an infected peripheral wound, while thrombophlebitis accompanies the infectious fevers, childbirth or operating wounds of the lower abdomen. In thrombophlebitis skin markings develop slowly, if at all; edema is immediate and pits on finger pressure and the lymph glands are not involved.

8. *What Sequels May Be Anticipated?* In the arm one must watch for a palmar abscess, local lymph gland abscess, or a diffuse phlegmonous abscess of the subcutaneous tissues. In the head and face one looks for spreading thrombophlebitis or submental or submaxillary lymph gland abscesses. In the leg one watches for a

saphenous or inguinal abscess and in any location, for systemic septicemia or pyemia.

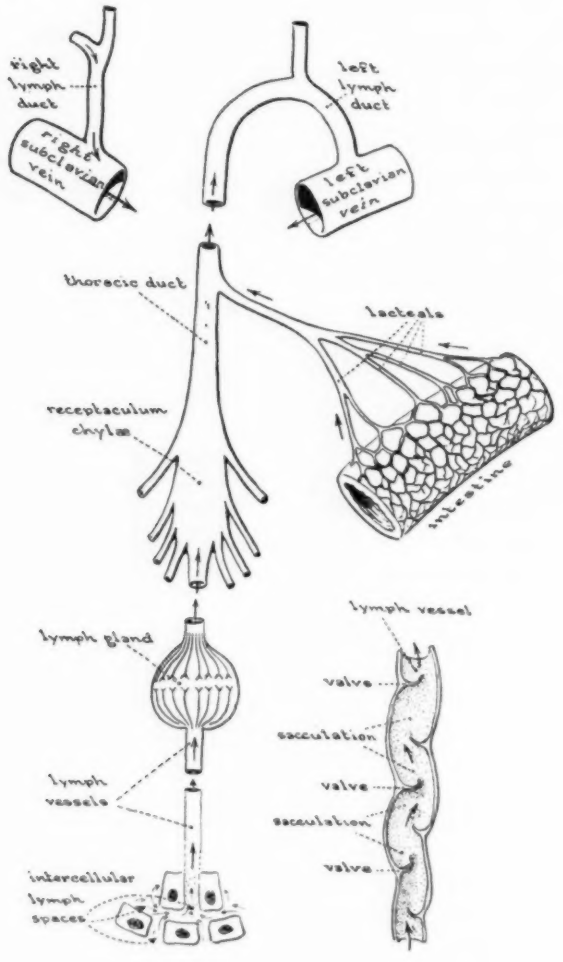

Fig. 1. Schematic chart of the lymphatic system. A. The lymph originates in the intracellular lymph spaces. From these spaces emerge the peripheral lymphatic vessels. The peripheral lymphatic vessels run into and break up in the lymph nodes. The lymph nodes filter, antitoxicate and sterilize the peripheral lymph. After leaving the lymph nodes all the deeper lymph vessels, except those of the right side of the face, neck, chest and right arm, empty into the receptaculum chylae and thoracic duct. The intestinal lacteals empty into the thoracic duct. The thoracic duct empties into the left subclavian vein through the left lymph duct. The right lymph duct empties into the right subclavian vein. There are two general lymphatic systems, the superficial and the deep, which have but slight communication through the deep fascia. B. The lymphatic vessels have many valves and tend to sacculate above each valve. These sacs give the beaded feel to superficial lymphangioma and to the palpable lymphatic vessels in chronic lymphangitis.

9. *What Surgical Principles Are Involved in the Immediate Treatment? Why? How Are These Clinically Applied?* The principles of treatment are rest, stimulation of the local active hyperemia, elimination, combat

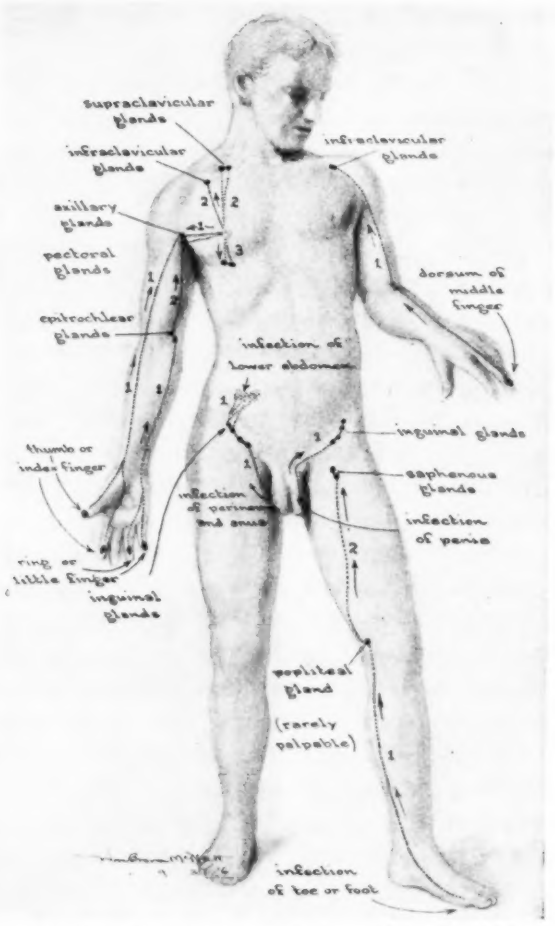

Fig. 2. Lymph drainage of the arm, breast and leg. Arm—Palmar surface: from the ulnar side of the hand and forearm; to the epitrochlear glands; to the axillary glands. From the radial side of the hand and forearm, directly to the axillary glands. Dorsal surface—to axillary glands, except middle finger which may run directly into the clavicular glands and subclavian vein. Breast—first to the axillary; then the clavicular; then the subpectoral glands. Leg—Feet and calf—to the popliteal glands, which are rarely palpable; to the vertical set of glands lying over the saphenous opening. Genitalia, arms, perineum, lower abdominal wall—to the oblique inguinal chain of glands along Poupart's ligament.

the systemic toxic acidosis; i.e., to assist the natural processes which the body calls forth to combat infection.

Why Immobilization? Because of the clinical results obtained in the cases so treated. It was formerly taught that the movement of the lymph was a very slow

process and that it was largely due to muscular action. Hudack and McMaster[2] upset this hypothesis when they showed that dye diluted with toxins, injected intradermally in the hand reached the drainage trunks in the axilla in eight minutes. Nevertheless there is abundant clinical evidence to show that infection spreads more rapidly in the active than in the passive member; and that movement must interfere with the barrier wall of protective elements which Nature throws around the infected site.

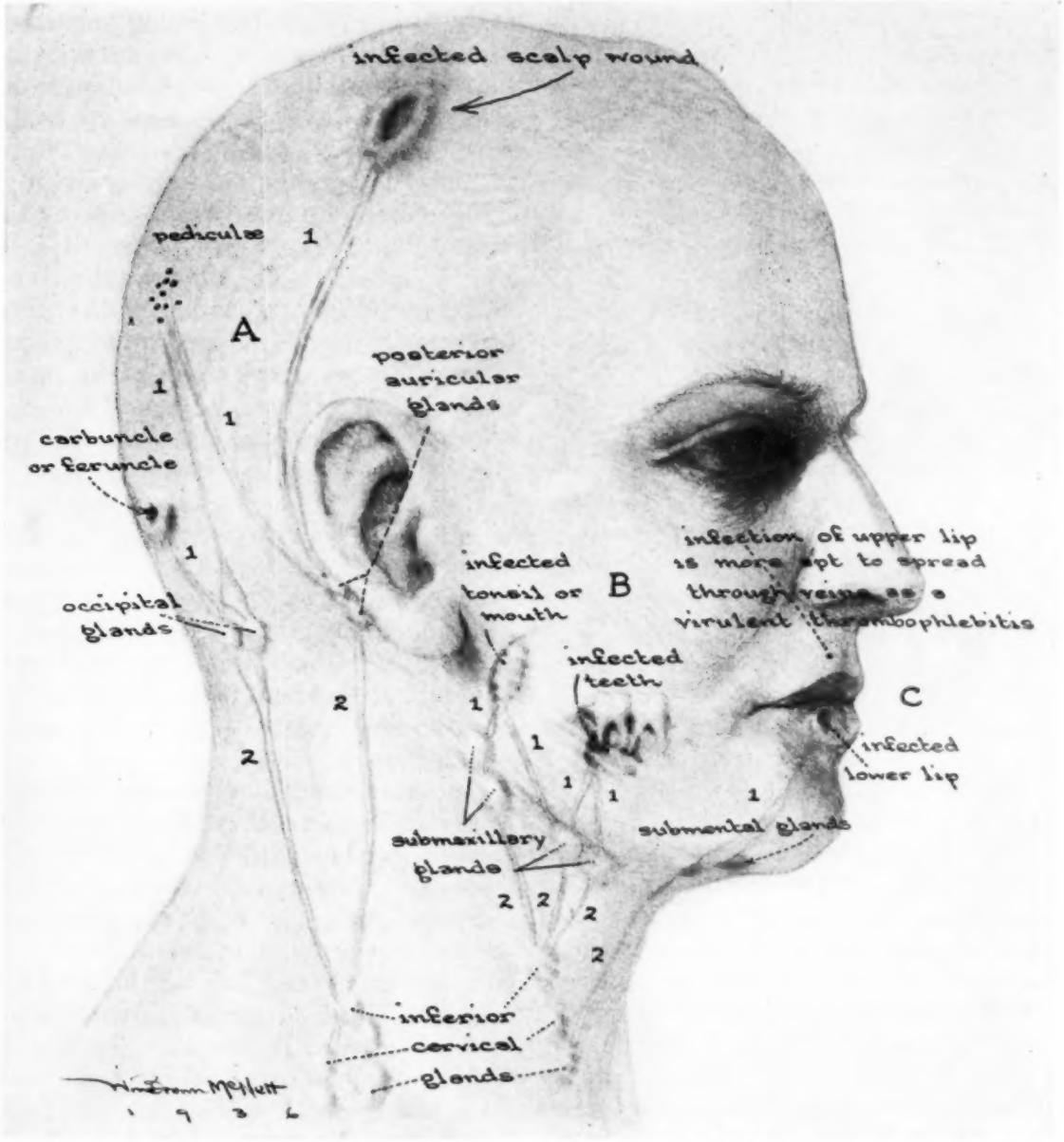

Fig. 3. Lymph drainage of the head, mouth and lips. A. Scalp (wounds, pediculi, furnucle or carbuncle) to occipital or postauricular glands; to glands of posterior triangle of neck. B. Mouth (ulcer, teeth, tonsils) to submaxillary glands; to glands of anterior triangle of neck. C. Lips. Lower (infection, herpes, cancer, chancre)—to submaxillary glands; to glands of anterior triangle of neck. Upper (carbuncle)—rarely to anterior auricular glands. Infection is more apt to spread through the veins as a virulent thrombophlebitis.

Why Encourage the Local Inflammatory Swelling by Hot Wet Compresses? The

[2] Hudack, S. S. and McMaster, P. D. The lymphatic participation in human cutaneous phenomena. *Jour. Exper. Med.*, 57: 751–777, 1933.

local swelling and redness is caused by inflammatory exudate. This exudate is composed largely of leucocytes, red blood

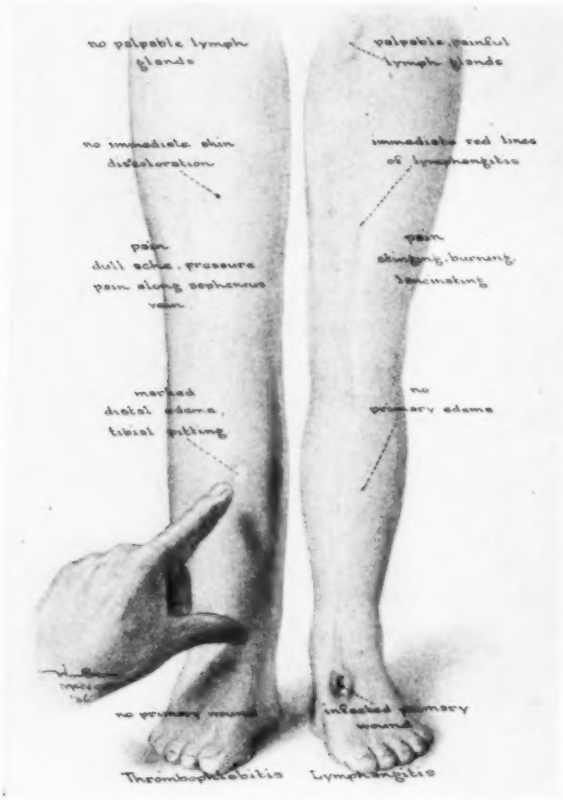

Fig. 4. Differential diagnosis between lymphangioadenitis and thrombophlebitis of the leg.

cells and plasma; i.e., the protective blood elements which are attempting to wall off and destroy the invading organisms and neutralize their toxins. Wet heat attracts blood and relaxes the tissues; thereby increasing the local concentration of the protective blood elements.

Why Force Fluids? To carry off by elimination through the kidneys, the bowels and the skin, the toxins circulating in the blood stream.

Why Combat Acidosis by Alkalies and Glucose? Because blood toxins are acids and their neutralization renders them less lethal.

The clinical plan of treatment may be summarized as follows:

Put the patient in bed and immobilize the arm or leg under an electric light cradle at a temperature of 105 to 110 degrees F. In face cases place sand bags to the sides of the head and avoid talking or swallowing. Cover the parts by massive, warm, wet, sterile saline dressings and keep them wet and warm, with no manipulative irritation of the primary lesion. The wet dressings keep it open and insure drainage. The exception is where the focus is covered by new epithelial growth or is an infected blister. Here gently cut through the overlying epithelium but do not draw blood. Force fluids by mouth, proctoclysis or hypodermoclysis. The latter method is sure and efficient. Neutralize acidosis by glucose intravenously and sodium citrate by mouth.

10. *What Is the Treatment of the Sequels-Palmar Abscess, Localized Glandular Abscess, Diffuse Purulent Cellulitis, Septicemia?*

Palmar Abscess. Clean cut incisions in the palm and above the wrist; wet dressings; no drains; Bier's passive hyperemia by an elastic bandage to the upper arm, two hours on and two hours off; soak the hand in hot saline fifteen minutes between the rubber bandage applications; squeeze the pus out gently through the incisions twice daily.

Localized Glandular Abscess. Wait for superficial fluctuation then open by a simple incision without retraction, curettage or digital exploration. A purulent lymphadenitis means that the infection has broken down the main line of defense; i.e., the lymph glands. The wall of leucocytes and fibroblasts surrounding the now functionless glands, is Nature's limiting wall against further entry of infectious matter into the systemic circulation and should not be broken down.

Diffuse Purulent Cellulitis. Simple incisions are to be made over each fluctuating area as it presents itself.

Septicemia. From the mortality standpoint septicemia falls into three classes; those cases which make a natural recovery irrespective of treatment; those which die in spite of every effort to save them; and the borderline case which immediate, vigorous therapeutic measures may pull

through. Blood, glucose and saline are today the only known agents which may convert a near septicemic fatality into a convalescent. Repeated blood transfusion is the main therapeutic factor; glucose and saline are accessories. Anti-streptococcic sera have proved disappointing. In this fulminating condition, where days or even hours count, delay while this or that vaunted form of serum therapy is used may mean death or recovery. Analysis of 1000 recent blood transfusions at Temple University Hospital[3] showed that in over 60 per cent of the cases the indications for its use was some form of septicemia. The septic states were of every known etiology and involved practically every part of the body. In favorable cases, irrespective of location, there was a check of the spreading diffuse cellulitis or general toxic symptoms and a tendency to local abscess formation. The dose used was 250 c.c. of whole blood given every second day. The average number of transfusions was eight. Intravenous glucose was given on the days between the transfusions. Continuous hypodermoclysis of Bartlet's solution, novocaine, grains 5 in one pint of saline, was given until the crisis was passed.

SUMMARY

1. The term acute lymphangio-adenitis is suggested to designate the conditions.

2. Serious infections follow trivial skin wounds in those whose occupations predispose to skin soiling with infected material, i.e., doctors, nurses, laboratory technicians, undertakers, or in the diabetic.

3. The red skin lines running from a skin wound to the nearest tender lymph node is the primary symptom.

4. The serious case shows, within two to six hours, rapid spread of local signs and a chill within the first thirty-six hours.

5. To date no serum therapy has been brought forward of avail in the fulminating case, nor does the blood picture or the germ type aid us in prognosis.

6. The lymphnodes involved are fairly consistent in infections of the different body areas.

7. A differential diagnosis between acute lymphangio-adenitis and acute thrombophlebitis is outlined.

8. Sequels to be expected in infections of different body areas are presented.

9. Primary local treatment is directed toward assisting those natural processes which the body calls forth to combat infection, i.e., rest; large, wet hot compresses; no local meddlesome surgery.

10. Plan of treatment of the sequels, i.e., palmar abscess, localized glandular abscess, diffuse purulent cellulitis, septicemia, is presented. Blood transfusion is the most reliable agent for septicemia, assisted by saline hypodermoclysis and intravenous glucose.

[3] Records of General Surgical Service, Temple University Hospital.

HUMAN BITES

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IT has been the experience of every surgeon to see the severe infections which frequently follow wounds produced by human bites, or other injuries produced by human teeth. These wounds, usually on the hands, produce infections which tend to spread diffusely as phlegmonous processes, discharge a foul pus, yield slowly to treatment, and end not infrequently with deformities or amputations.

It is possible to reduce the frequency and severity of these infections but to do so one must appreciate the factors responsible for the poor results. These are, the nature of the wound, the immediate introduction into it of organisms of a high degree of virulence under such conditions, and the anatomical relations of the areas most frequently involved.

The wounds are usually of the penetrating, puncture type with considerable destruction of surrounding tissue because of the nature of the force used. It is well known that wounds associated with tissue death are more likely to become infected than the clean incised type, and so it is not surprising that the less common type of tooth wound which produces an avulsion is less frequently followed by a serious complication.

Into these wounds are introduced a variety of organisms commonly found in the human mouth, such as Staphylococcus aureus and albus, streptococcus of various types, the fusiform bacillus and spirillum of Vincent's angina, and numerous spirochetes. In numerous instances syphilis has been transferred by the bite of an active luetic. The infection is rarely due to any single organism but is a true mixed infection. The Vincent's organisms and spirochetes when present are responsible for the foul smelling, gangrenous nature of the wound, and when their presence may be shown by smear or culture the outlook is serious.

About 80 per cent of these injuries occur on the hands and fingers. The most common place is over the metacarpophalangeal joint of the middle or index finger, and it is caused by striking the clenched fist against the teeth of another. At this point virulent mouth organisms may be implanted directly into the subcutaneous tissues, tendons, subtendinous area or the joint. The anatomical arrangement here is such as to allow easy spread of infection in several directions. For an appreciation of these anatomical factors and the method of spread one is referred to the excellent work of Mason and Koch. The injection experiments of these investigators show the ease with which infection starting in the areas commonly involved in bites, spreads over and up the dorsum of the hand, distally along the fingers and anteriorly through the lumbrical to the palmar spaces.

The ordinary surgical treatment of these has proved unsatisfactory to most observers. Because of this fact Bates was led to treat all bites by electrocauterization. The patient was given gas anesthesia and with the electrocautery enough tissue was destroyed to remove the entire tooth mark. The treatment was used early preferably but in some cases as late as the third and fourth day. The decrease in the incidence of infection was very striking, in over 130 cases severe infection occurred twice only. In a recent report Lowry calls attention to the excellent results obtained by Bates and while admitting the excellence of the method, commented on the difficulties in persuading patients to permit gas anes-

thesia to be given and the unavailability of both the anesthesia and the electrocautery in many instances. As a simpler method of treatment he recommends the careful cauterization of the wound with fuming nitric acid, followed by a flushing with cold water. The method is painful for a short time only and is easily accomplished. In 122 cases treated by this method the result was satisfactory in 97 per cent of the 64 which were followed through. Another recent paper by Welch recommends the use of the electrocautery in deep wounds especially those involving the knuckle joint, and fuming nitric acid in the minor wounds.

The author's practice has been to use fuming nitric acid for cauterizing all bites, both human and animal. In those cases in which infection is already present when first seen, adequate incisions should be made. Most complications follow inadequate drainage so it is important to plan the incisions with due regard for the anatomy as revealed in the work of Mason and Koch.

SUMMARY

Human bites produce infections of an extremely virulent nature because of the type of wound, the organisms introduced, and the anatomical arrangement of the parts involved.

These infections not only cause a great loss of time to the individual, but often cause loss of function in parts of the hand, amputations of digits and extremities, and occasionally death.

The treatment outlined will reduce considerably the incidence of infection and reduce its severity when it does occur:

1. Cauterization of all wounds thoroughly with fuming nitric acid or an electrocautery. No attempt should be made to close the wound.

2. All infected wounds must be carefully but radically incised without delay, unless marked lymphangitis is present. Following incision warm moist dressings should be used followed by irrigation with potassium permanganate 1:1000, hydrogen peroxide or other oxidizing solution.

REFERENCES

Bates, W. Electrocauterization in the treatment of human bites. *Ann. Surg.*, 93: 614, 1931.

Lowry, T. M. The surgical treatment of human bites. *Ann. Surg.*, 104: 1103, 1936.

Mason, M. L. and Koch, S. L. Human bite infections of the hand. *Surg. Gynec. and Obst.*, 51: 591, 1930.

Welch, C. E. Human bite infections of the hand. *New England Jour. Med.*, 215: 901, 1936.

NEW METHOD FOR TRANSFER OF FULL-THICKNESS SKIN: GRILLE GRAFT*

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THE plastic surgeon is often confronted with conditions demanding the use of full thickness skin for reconstructive and corrective purposes. Free grafts are not always successful and they leave unsightly scars on donor sites. The tubed pedicle of Gillies is almost uniformly successful but requires two or more operations, long hospitalization, uncomfortable immobilization and return to society is long deterred. It has been the practice of the writer, when the tube shall have served its purpose, to discard the proximal unused segment instead of replacing it in its original bed. In this way, a single longitudinal scar results, where replacement necessitates two and this also avoids an additional operative procedure. Results of pinch grafts are not pleasing cosmetically, on either donor or recipient sites.

FIG. 1. Condition before Grille graft was applied.

Douglas has devised the "sieve graft," which has been very satisfactory in the writer's experience but the donor site is large and slow to heal and the dissection, leaving the islands of intact skin on the donor site, is tedious, slow and difficult. No undermining of adjacent skin is practical, as it would result in covering the islands and defeat the object for which they were intended. Of course, it might be practical to leave a larger area of intact skin at the free edges of the graft, thereby making fewer islands and then undercut the donor site edges and partially close the wound. It would still be tedious and take much time to dissect around these several islands.

So, in a effort to overcome these difficulties and objections, the author presents an original method and has called it the Grille graft.

It consists of leaving one, two or more narrow parallel strips of skin on the donor site undisturbed to act as islands, establishing centers from which healing begins to take place very early postoperatively.

Very little, if any, allowance need be made for "shrinkage" of the graft during its application to the recipient site, in contrast to the "sieve graft" where it is recommended that the graft be about 25 per cent oversized. This, of course, means the area from which the skin is taken, is larger and slower in healing.

Surrounding edges of the donor site may be undermined to varying degrees, drawn toward the islands and sutured to them, thereby effacing a large area of the defect left by the removal of the graft.

The recipient site is prepared in the usual way, removing exuberant granulations when necessary, applying hot pads and pressure to obtain as nearly complete hemostasis as possible. A pattern or

* Read before the Brooklyn Surgical Society, December, 1936.

template may be made, after the recipient site shall have been prepared and applied to the donor site as an outline, then transfer

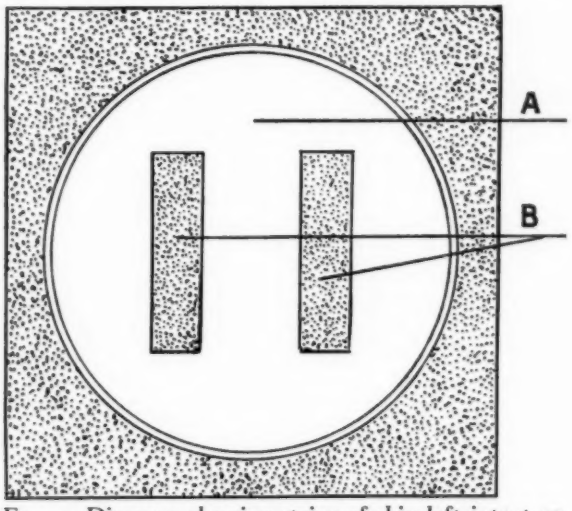

Fig. 2. Diagram showing strips of skin left intact on donor site; A, graft; B, skin left intact on donor site.

the full thickness skin and suture it carefully in place, accurately apposing the edges. This leaves one, two or more

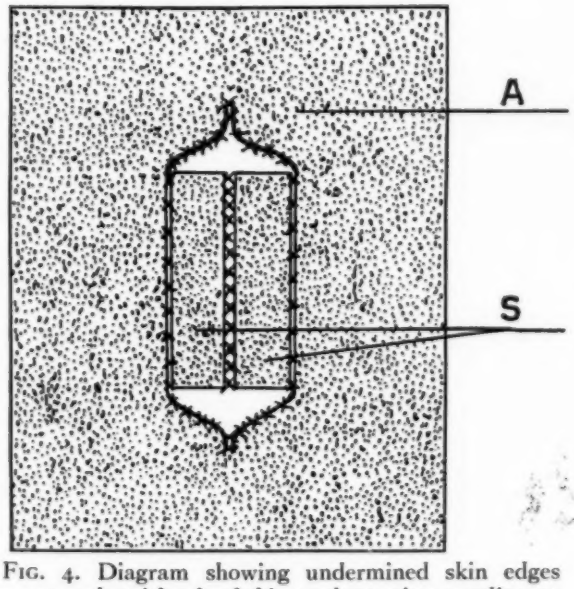

Fig. 4. Diagram showing undermined skin edges sutured to islands of skin on donor site; A, adjacent skin undermined, slid and sutured to itself and to intact skin; S, skin left intact on donor site.

"ventilated" areas, according to the size of the graft, to allow the escape of serum and air bubbles, when sea-sponge shall have been applied.

Following is a typical case report

A. S. age six years, colored male, was admitted to St. John's Hospital, Brooklyn, with extensive burns of the arms, abdomen and

Fig. 3. Donor site after removal of graft following technique shown in Figure 2.

chest. The surfaces were tanned early and fairly good results were obtained except for two

Fig. 5. Undermined skin edges sutured to islands on donor site, as shown in Figure 4.

areas on the extensor surfaces of the left elbow, about 3 by 5 cm., which resisted treatment and skin grafting was elected.

On May 29, 1936, Grille grafts were raised from the anterior surfaces of both thighs and transferred to the left elbow. Usual sea-sponge

dressing was applied to the recipient site and vaseline gauze to the donor sites.

Healing progressed, the grafts having "taken" to such an extent that an older patient might have left the hospital at the end of the fourteenth day. The wounds were firmly healed and all dressings removed at the end of twenty-one days.

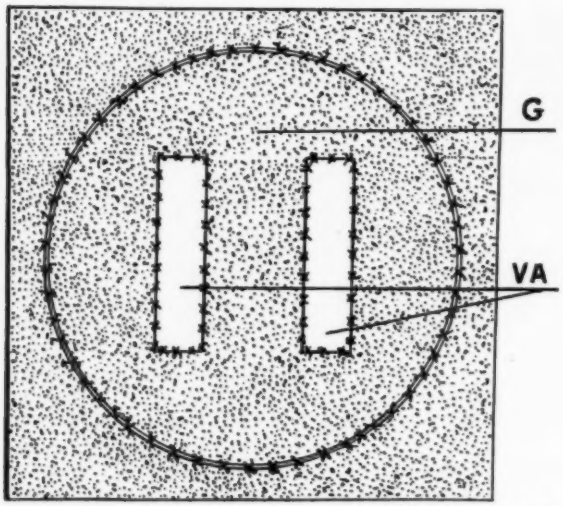

Fig. 6. "Ventilated" areas of skin having been left on donor site; G, grilled graft sutured into recipient site; showing VA, "ventilated areas."

Fig. 7. Two Grille grafts sutured in place, as shown in diagram in Figure 6.

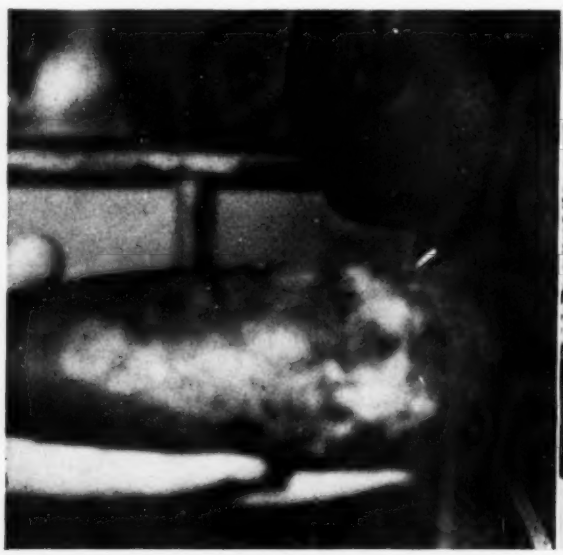

Fig. 8. Recipient site healed, twenty-two days.

Fig. 9. Donor site healed, fourteen days.

CONCLUSIONS

The advantages claimed for this method are as follows:

1. The ease with which the graft is raised; ten minutes is the usual time necessary to dissect a moderate sized graft with two openings;
2. Partial closure of the donor site;
3. "Ventilation" of the recipient site;
4. Rapid healing and presentable scars at both sites;
5. Less restriction of the parts by immobilization, and shorter hospitalization; together with the advantages of the sieve, the tube and other full thickness skin

transfers, namely, prevention of subsequent contractures, as in flexor surfaces such as the popliteal and axillary spaces;

6. Prevention of desquamation and "cracking" on extensor surfaces, such as the elbow, knee and other locations where skin and superficial fascia are not plentiful;

7. The restoration of denuded areas on scalp or skin, following the deep removal of malignant growths; and

8. In indolent varicose ulcers.

A B

Fig. 10. A, Complete excision of all the scar tissue could not be accomplished because of its density and its extent from the forearm to the chest, hence the grafts were sutured to the surrounding areas of abnormal skin; B, end-result four months postoperatively, showing almost complete extension and healed areas of donor site.

BURNS*

A DISCUSSION ON THEIR TREATMENT, BOTH IMMEDIATE AND REMOTE, WITH SPECIAL EMPHASIS ON THE PREVENTION OF SCARS AND CONTRACTURES

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THIS paper is based on a series of 300 consecutive cases of sufficient severity to warrant hospitalization. The entire treatment, both medical and surgical, is supervised by a small group of men who are on service throughout the year so that there is a continuity of treatment and method which works for the advantage of the patient. Many of our scar cases are hospitalized for several months at a time and we are thus able to carry out lengthy and time-consuming medical and surgical procedures without the usual interruptions which take place with a change of services. These cases have been personally supervised by the writer within the past three years.

CLASSIFICATION OF BURNS

The time honored classification of burns has been that of the first, second and third degrees, depending on the depth of the burn, from the superficial erythema to bleb formation and finally to destruction of the skin and the underlying structures; this however presents a very inadequate survey of a case. The location and extent of the burn is also of the utmost importance. In addition the following questions must be considered: Is the burn old or recent? Is it clean or infected? And if infected, what is the predominating organism? What is the age of the patient? Are there any complicating factors such as senility, diabetes, alcoholism, epilepsy, heart or pre-existing kidney involvement? What caused the burn? Chemicals, flame, electricity, hot liquids, *x*-ray or radium, the sun? Are any special areas such as flexor surfaces, the eyes, mouth, throat, perineum involved? What is the condition of the patient on entering the hospital? Is he in shock, pain, dehydrated, toxic, emaciated? Does his urine show secondary kidney changes? Any previous treatment? How much normal skin is left? What is the probable prognosis?

A survey such as this, on the first examination of a patient with any burn is important in outlining a course of treatment. To help in the standardization of our methods in so far as possible, the following chart was devised and is used in every case as an integral part of the record. Prior to this all our cases were photographed in an attempt to show the types and extent of the areas involved. This chart is more satisfactory for all these questions are answered, and the burned area can be accurately mapped out.

TREATMENT, IMMEDIATE

No attempt is made to discuss the merits of the various methods advocated for the treatment of burns, and the role of infection is so important that it will be taken up at some future time. Suffice it to say that the multitude of methods and medications, all effective in the hands of the individual worker, is indicative that no one treatment should be the "accepted one."

The following is the routine treatment in use on our service: On admission, measures are taken to relieve pain by the generous use of morphine or codeine or tincture opii in children. Shock is combatted by the administration of fluids by all available routes, the use of external heat and

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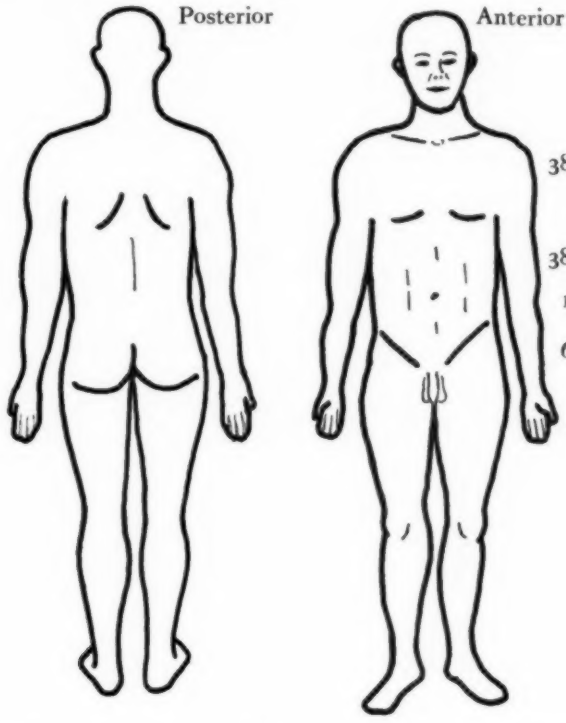
stimulants. All clothing and debris are removed. Tetanus antitoxin is given. A complete debridement is done on the wards, anesthesia rarely being needed; the skin is cleaned; all ointments are removed and if acid or alkali burns are present, the offending substance is washed off with copious quantities of normal saline and then the appropriate antidote applied.

The question arises as to what to apply to the burned area. We have used the following, tannic acid from 5 per cent to 10 per cent, gentian violet 1 per cent, tannic acid 5 per cent and gentian violet 1 per cent combined, a tannic acid jelly, picric acid ointment, silver nitrate solution 10 per cent, and irratdiaed petroleum, and a cod-liver oil ointment. Each is useful, none can be universally used. Our preference is for the freshly prepared tannic acid and gentian violet mixture. This is sprayed on the burned areas every fifteen minutes and dried with a hot air blower similar to that used in the hair-dressing establishments.

Name.....Age.....Color.....



Legend: 1° ////
2° 000000
3° xxxxxx

% Scale
38% Buttocks & L. Exts. foot—1/6 leg—2/6 thigh—3/6
38% Trunk and neck
18% Upper exts. hand—1/4 arm—3/4
6% Head

Type: a. Recent.....Old.....Previous Treatment.....
b. Clean.....Infected.....Pot. Infected.....

Percentage: 1°.....2°.....3°.....

Joints & Special Areas Involved: Elbow..... Fingers..... Axilla..... Neck..... Knee..... Other.....

End Result: Died..... Healed..... Scarred..... Contracture..... Cosmetic..... Functional..... Other.....

Cause: .....

Prognosis: .....

Operations: Yes..... No.....

Complications: .....

Fig. 1. Burn chart, Division of Plastic Surgery.

This is done for a period of two hours, then at longer intervals for the next twenty-four hours. A firm, soft coagulum is formed,

Fig. 2. Hypertrophied contracted scar of anterior neck.

Fig. 3. Extensive unstable scar of back accompanied by contracted scar of axilla.

pain is relieved, fluid loss is decreased, body heat is preserved and infection is minimized. The patient is at all times upon a sterile sheet, and is under an electric light cradle, where a constant temperature of 99 degrees F. is maintained.

The continuous intravenous administration of fluids is useful in the early treatment of extensive burns and later, a high vitamin and high caloric diet is prescribed. Patients with burns of the chest and abdomen are turned from side to side frequently, as allowing them to remain on their backs for weeks at a time predisposes to a hypostatic pneumonia, especially in elderly people.

An extensive burn usually means a long period of hospitalization and the case should be treated as one would treat a chronic bedridden patient. Bed sores, etc., should be prevented.

Anemia is a frequent complication in the extensively burned and the blood count is often misleading due to concentration. A distinctly anemic patient from the standpoint of clinical observation may present a blood count which belies his physical appearance.

Fig. 4. Hypertrophied contracted scar of face and neck.

In such cases we favor the use of small indirect blood transfusions of 75 to 100 c.c.,

used early and frequently until there is a distinct improvement in the color of the skin and mucous membranes. The transfusions are usually supplemented by quartz light in tonic doses.

Early skin graft is used if the flexor surfaces about the joints are involved. These areas should never be allowed to heal by slow epithelization if there is any question of limitation of motion or loss of function. If so allowed, extensive deforming, contracting scars are the result; either the unstable parchment-like type or the hypertrophied contracted variety.

The time loss in these cases as compared to those grafted is considerable and the great responsibility of the surgeon, to the patient who has survived extensive burns, is the preventing of these deforming and incapacitating scars.

It is important that skin grafting be performed before deep scarring takes place especially in such regions as the elbow, the popliteal space, the axilla, the anterior neck region and the fingers. Apparently insignificant burns, especially of the hands, may be followed months later by contracted and distorted fingers. The well equipped ward should have several fracture beds on which vertical, horizontal and longitudinal tractions, with pulleys, can be erected.

The ingenuity of the surgeon is often taxed to the limit, especially where children are concerned, for they are notorious for their ability to slip out of all sorts of casts and extension devices.

Many weeks of this traction may be needed and it must be supplemented by massage and passive motion, etc., long after a cure is apparently obtained.

The incidence of contractures, which have developed on our service following such procedures has been small.

PROGNOSIS

The prognosis except in cases obviously not dangerous must be guarded. Death from shock within the first forty-eight hours, occasionally occurs, especially in elderly patients. Children apparently well on the road to recovery, may suddenly go into convulsions and die. Diabetes, nephritis, etc., are very dangerous accompanying diseases.

The prognosis as to the limitation of motion, loss of function, etc., is the important one. The surgeon should see to it that the important regions mentioned should be guarded with the utmost care, in order that the afflicted patient may be returned to his world as nearly normal as possible.

The accompanying photographs illustrate some of the contractures resulting from long periods of epithelization.

SUMMARY

Not enough stress has been laid upon the prevention of contractures following burns.

The location of the burn is often more important than the degree.

Early skin graft should be performed in all extensive burns.

The primary survey in which the location of the burn and the amount of normal skin remaining are determined and are all important.

To prevent contractures not only must mechanical appliances be used, but a long follow-up period of massage, active and passive motion, etc., is necessary. This must be continued long after the burn has healed.

TREATMENT OF BURNS WITH BRILLIANT GREEN

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THE treatment of burns underwent great changes in the last decade and is now dominated by the use of tannic acid, either the original Davidson method[1] or one of the numerous modifications. Taylor[2] recently called attention to the misuse of tannic acid in milder, "second degree" burns, as many of the epithelial cells that might take part in the repair of the denuded area, are "tanned" by the treatment and repair is thus delayed.

It is not the intention of the writer to detract from the value of the tannic acid treatment but the method has its limitations. Aldrich[3] suggested the use of a 1 per cent solution of gentian violet which destroys germinal epithelium to a lesser extent than tannic acid and does not cause the severe local reaction encountered after "tanning." De Hart[4] reported favorable results obtained with this method. Another anilin dye, brilliant green, has been found still more efficacious.

Krumwiede and Pratt[5] studied the bacteriostatic effect of this dye and found that the inhibition of growth has been most evident among the Gram-positive bacteria. Ligat[6] reported very satisfactory results with this dye. Browning et al.[7] recommended the use of brilliant green for treatment of infections caused by the cocci group; they found the bactericidal power of the dye to be considerably lower toward Bacteria coli. Kligler[8] in an extensive study at the Rockefeller Institution found brilliant green an effective antiseptic in the following dilutions:

B. aerogenes	1– 100,000
B. coli	1– 675,000
B. typhosus	1– 510,000
B. proteus	1– 675,000
B. subtilis	1–15,000,000
S. aureus	1– 4,000,000

Norton and Davis[9] state that brilliant green is the most active dye they found, as far as bacteriostatic action on Streptococcus viridans and pneumococcus is concerned.

Baccal[10] revived the interest in brilliant green by recommending its use in minor surgery, in preoperative preparation of the skin, in sterilization of the hands, catgut and surgical instruments and treatment of burns and certain external eye diseases, such as blepharitis. In 1931 the writer[11] offered a clinical study of the value of brilliant green as a local antiseptic. In 1934 he also reported a large series of various pyogenic conditions favorably treated with brilliant green. Morrow[12] uses a mixture of 1 per cent gentian violet and 1 per cent brilliant green in a 50 per cent alcoholic solution for the tinea-like condition between the webs of the toes. Brind[13] highly recommends brilliant green for the treatment of pyodermia, furunculosis, deep trichophytosis, folliculitis, scabies, and eczema complicated by pyogenic infections. He uses aqueous or alcoholic solutions, powders or pastes containing brilliant green. Ryles[14] found that injections of "Bonney's Blue" which consists of brilliant green and crystal violet, are at least as effective in leprosy as chaulmoogra oil. Korytkin-Novikov[15] treated 48 burn cases with brilliant green; in 31 a second degree burn was present; a complete regeneration of skin was obtained. In 6 deep burns an elastic, movable scar resulted. The hospitalization time was markedly shortened. Kozdoba[16] infected artificially produced wounds in animals with Bacterium coli, streptococcus, staphylococcus, Bacillus pyocyaneus and tetanus bacillus and compared the effect of brilliant green, pyoctanin, rivanol, tincture of iodine, bichloride of mercury, hypertonic

solution of sodium chloride and sodium acetate. Rivanol, brilliant green and pyoctanin were found to be the most effective drugs. A pharmaceutical company informed the writer that it began using brilliant green in March, 1930, in the manufacture of smallpox vaccine. The product carries a much lower amount of organisms per centimeter than the maximum required by government regulations. Ingram[17] praises the use of a mixture of hydrogen perchloride and brilliant green in the treatment of sycosis. Nakashima[18] found injections of brilliant green into the peritoneal cavity to be harmless. Kline[19] studied the toxicity of brilliant green for certain bacteria; he presented a method by which it seems possible to determine the bacteriostatic titer in a given sample of brilliant green.

Brilliant green chemically is a diaminotriphenylmethane compound. The product is a green powder, soluble in water and alcohol. The aqueous solution is not stable and should be freshly prepared. Brilliant green offers the following advantages in the treatment of burns:

1. Great inhibitory power toward the common pathogenic microorganisms;
2. Rapidity of action;
3. No deleterious effect on phagocytosis and other defensive processes of the organism;
4. Absence of irritating effect; and
5. Stimulation of granulation tissue.

All these properties make brilliant green very desirable for the treatment of burns. The only disadvantage seems to be the staining property of the dye. The stains may be removed from cloth by the use of a solution containing 90 per cent alcohol and 10 per cent dilute hydrochloric acid. Stains can also be removed by immersing clothing in a solution prepared by dissolving about 200 gm. of sodium perborate in 50 liters of hot water. After immersion the solution should be brought to a boiling point and allowed to boil for approximately one-half hour. If any stains still remain, they can be easily removed by applying good soap or soap powder directly to the stained spots, then thoroughly rinsing and drying the clothing. Another method is as follows: to every 4 oz. of hot soap solution add one tablespoon of hydrogen peroxide; immerse clothing and leave for some time in hot solution; rinse well in cold water and dry. The stains on the hands can be removed by vigorous rubbing with alcohol.

In treating burns with brilliant green, the surrounding skin is painted with a 1 per cent solution of brilliant green in 60 per cent alcohol. After the customary toilet of the wound, the burned area is painted with a freshly prepared 1 per cent aqueous solution of brilliant green. Alcoholic solution is not advisable for the first treatment because it produces a smarting sensation. After three to five days, when the initial pain has subsided, the alcoholic solution can be used. The burn is covered with a thin layer of gauze. The applications are made once or twice a day, according to the amount of secretion. After a few days the alcoholic solution is substituted by a brilliant green jelly, which consists of a 1 per cent pure brilliant green in a water soluble jelly base of gum tragacanth. This jelly is allowed to dry on the wound for five to ten minutes and is then covered with a thin layer of gauze coated with sterile vaseline. This precaution is necessary, as otherwise the gauze adheres to the jelly and the change of dressing might be painful. The gauze is changed every two to four days if there is any secretion. Generally, however, no change is required for several days because the jelly forms a soft, flexible crust which has a dehydrating effect.

It goes without saying that the customary procedures to combat an existing shock are carried out; the usual systemic treatment is employed. If the patient is hospitalized, the burn is not covered with dressing; a light bulb is placed in the cradle.

As compared with the tannic acid treatment, this method offers the following advantages:

1. No frequent spraying is required.

2. The wet, oozing areas become dry without any chance of accumulation of pus under the eschar.

3. Brilliant green does not destroy the germinal layer but, on the contrary, it stimulates granulations.

Large series of comparable cases with deep burns must be treated with tannic acid or brilliant green to establish their relative values. In the treatment of second degree burns brilliant green seems to be superior to tannic acid in view of the features mentioned.

SUMMARY

Brilliant green offers the following advantages in treatment of burns:

1. Inhibitory power toward the common pathogenic microorganism;
2. Rapidity of actions;
3. No harmful effect on phagocytosis and other defensive processes of the organism;
4. No irritating effect; and
5. Stimulation of granulation tissue.

As compared with the tannic acid treatment, this method offers the following advantages:

1. No frequent spraying required;
2. The wet, oozing areas become dry without any chance of accumulation of pus under the scab; and
3. Brilliant green does not destroy the germinal layer but, on the contrary, it stimulates granulations.

REFERENCES

1. Davidson, E. C. *Surg., Gynec. and Obst.*, 11: 202, 1925.
2. Taylor, F. *J. A. M. A.*, 106: 1145, 1936.
3. Aldrich, R. H. *New England Jour. Med.*, 208: 299, 1933.
4. De Hart, R. M. *Virginia Med. Monthly*, 62: 594, 1936.
5. Krumwiede, Ch. and Pratt, J. S. *Jour. Exper. Med.*, 19: 501, 1914.
6. Ligat, D. *Brit. Med. Jour.*, 1: 78, 1917.
7. Browning, C. H., Kennaway, E. L., Gulbransen, R. and Thornton, L. H. D. *Brit. Med. Jour.*, 1: 73, 1917.
8. Kligler, I. J. *Jour. Exper. Med.*, 27: 463, 1918.
9. Norton, J. F., and Davis, G. E. *Jour. Infect. Dis.*, 32: 220, 1923.
10. Baccal, S. A. *J. A. M. A.*, 95: 215, 1930; *Naukova Dumka* (Pamphlet in Ukrainian) 1930.
11. Narat, J. K. *Ann. Surg.*, 44: 1007, 1931; *Zentralb. f. Chir.*, 61: 2871, 1934.
12. Morrow, H. *Arch. f. Dermat. u. Syph.*, 25: 957, 1932.
13. Brind, A. I. *Soretsk. Vrach. Gaz.*, 17–18: 809, 1933.
14. Ryles, C. S. *Leprosy Rev.*, 4: 113, 1933; abst. in *Zentralbl. f. Haut- u. Geschlsky.*, 47: 178, 1934.
15. Korytkin, L. E. and Novikov. *Soretsk. Vrach. Gaz.*, 1: 22, 1934.
16. Kozdoba, A. Z. *Nov. Chir. Arch.*, 30: 181, 1934.
17. Ingram, J. T. *Practitioner*, 135. 479, 1935.
18. Nakashima, C. *Mitt. a. d. med. Akad. Kioto*, 4: 341, 1935.
19. Kline, E. K. *Am. Jour. Publ. Health*, 25: 314, 1935.

INFECTIONS OF HEAD

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THE frequency with which small injuries and infections of the head have progressed to a degree of severity that will cause either death, loss of an important structure or a disfiguring scar has caused surgeons for many years to search out the pathways of bacterial extension so that more efficient therapy could be undertaken. Unfortunately, very little of this information has been available in the literature and it is only in recent years that detailed anatomical studies have made possible clear explanations.

Any discussion of so grave and comprehensive a subject, which must be made within a limited time, will of necessity be limited in its scope to the more important factors involved and many of the less grave types of infection cannot be touched upon. In this paper, no attempt will be made to discuss infections involving the field of the otolaryngologist or ophthalmologist. Also, in spite of the fact that infection of the neck may be the result of extension from the head and vice versa, no discussion of these neck infections or anatomy will be undertaken except as it is necessary to clarify extension of infections in structures found in the face and cranium.

Historians have produced evidence that clinicians of ancient time were aware of the seriousness of this condition and translations of their writings are of great interest in the light of our modern knowledge. An ancient Egyptian Papyrus of about 1600 B.C. contained 48 case histories, mostly dealing with head injuries and infection. It clearly described the resultant complications so common to modern surgeons. Hippocrates published a treatise on "Wounds of the Head" about 400 B.C. In this manuscript he advised the use of wound irrigations by wine and clean water, the latter preferably boiled. He also suggested the close approximation of wound edges and gave the first description of healing by first and second intention. He also described many of the complications of head injuries and infections.

It seems best for purposes of clarity to divide this topic under two main headings; (1) the anatomy of the parts; and (2) the source and types of infections with their treatment. This will allow a fairly complete discussion of the important fundamentals to be taken up early so that they can be referred to later.

ANATOMY

Infections involving tissues of the head may spread to contiguous structures by one or more of three routes; (1) by the lymphatic system with its drainage of the involved parts; (2) by the vascular system in which both the arterial supply and the venous drainage are important and (3) by anatomical continuity. This anatomical discussion must necessarily be brief but a knowledge of it is of paramount importance for no understanding treatment can be undertaken without it.

The lymphatic vessels which drain the scalp and face are both numerous and complete and infections are always accompanied by glandular involvement. This is of great value as it often directs attention to the area in which the infection first starts before it is otherwise apparent.

The scalp is drained posteriorly by vessels that terminate either in lymph glands which lie superficial to the mastoid part of the temporal bone, or in occipital lymph glands which lie in the neighborhood of the superior nuchal line. Anteriorly these vessels end either in glands which are embedded in the superficial surface of the

parotid gland or in the superficial and deep cervical groups. The area above and about the ear is drained to the posterior auricular glands.

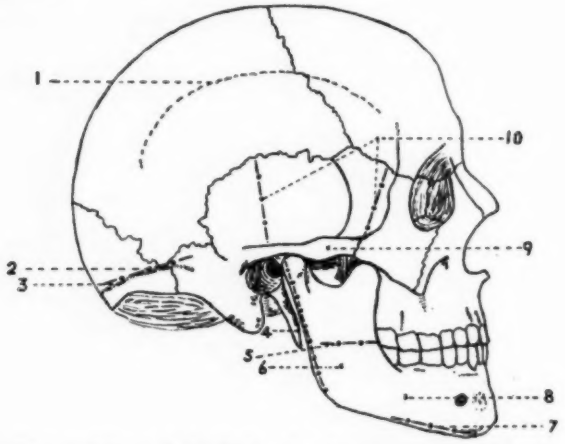

FIG. 1. View of skull showing important bony landmarks and site of incisions for closed spaces; 1, superior temporal line; 2, site to drain extravasations beneath galea and occipitalis muscle; 3, superior nuchal line; 4, site of incision to drain parotid space; 5, line of incision to drain masseter space; 6, ramus of mandible; 7, drainage site for buccinator space; 8, body of mandible; 9, zygomatic arch; 10, site of incision to drain temporal pouches.

The face has several minor groups of glands which in turn empty into larger chains. The deep and superficial vessels from the region of the nose and cheeks accompany the angular and facial veins and end in the submaxillary gland.

The vascular system of the head is very complete and tends to give every part a very rich supply and to provide in health a most adequate venous drainage. The end arteries anastomose freely both with similar vessels across the midline and with their neighbors. This allows ligations to be carried out on many of even the larger vessels without depriving tissues of their nutrition. In the scalp and superficial temporal region the vessels all enter from the periphery passing into the superficial fascia after piercing the deep fascia of adjacent regions. As a consequence of this arrangement, large flaps of the scalp may be torn from the center towards the margin, but so long as they remain attached at the periphery, there is no serious interference with their source of vitality and, if cleaned and replaced, healing occurs rapidly and satisfactorily, sometimes even without drainage. On the face the overlying skin is firmly attached to the underlying muscles by subcutaneous tissue. This network of fibers in turn envelops the arteries and veins and interferes with their normal ability to collapse and clot. Because of this, bleeding from a lacerated or eroded artery is prone to be profuse and continuous until firmly secured.

It is, however, in our newer knowledge of the anatomy of the venous system that explanations have been made for some of the peculiar extensions of infections in the face. The veins of the face and scalp accompany arteries of like name and normally drain the entire area without difficulty. The veins of the face present a unique anatomical situation for their lack of valves allows a back flow when there is an obstruction. Therefore, pressure from edema or exudate, or a thrombophelitis which would obstruct the facial vein or its tributaries, would reverse the current of blood. This immediately becomes a most serious problem for, as a result of the anastomosis of the angular vein with the superior ophthalmic, this reversed current will result in infection being carried through the superior ophthalmic into the cavernous sinus resulting in meningitis, sinus thrombosis or bacteriemia. Infections about the upper lip, lower portion of the nares and adjacent cheek are, therefore, always in danger of developing these highly fatal complications.

The ease with which bacterial exudates pass from one area to another or are limited to a restricted space leads us to a most important anatomical study. For these limitations are caused by muscular attachments and fascial planes. The enclosed glands, muscles or bones are of secondary importance as their reactions can easily be noted, but their point of dependent drainage would be unknown without a knowledge of the space within which they are defined.

A correct knowledge of fascial planes now plays an important role in clinical medicine for these planes exert pressure on

swellings that occur in organs which they envelop and thereby influence the shape of these swellings as well as control the pathway of suppuration into contiguous parts. Singer, by means of a new type of dissection, and Coller and Yglesias, by painstaking and laborious efforts have added greatly to our knowledge of these fascial attachments.

The fascia of the head is best divided for description into superficial and deep layers. The superficial fascia is a connective tissue covering for the face and cranium which differs according to the particular region. On the cranium it contains numerous fibrous septa which connect it with the skin and underlying galea aponeuratica. For this reason, incised wounds do not gape and swelling and suppuration are limited. On the face, it sends these same septa into the muscles of expression which are subcutaneous and firmly attached to the overlying skin.

There is no true deep fascia of the cranium but it has a definite fascial space or pocket in which infection spreads. This is in the loose areolar tissue that lies between the galea and the pericranium. This space is formed; laterally, by the attachment of the firm dense galea aponeurotica along the superior temporal line and about the mastoid bone; anteriorly, but its association with the frontalis muscle whose fibers in turn blend with those of the orbicularis oculi; and posteriorly, by its association with the occipitalis muscle that arises from the superior nuchal lines and by its own attachment to the nuchal lines.

Description of the fascial planes of the face is most difficult without the aid of anatomical specimens. If, however, one will visualize a skull with muscles, glands and overlying tissues removed so that only the fascia remains a clearer conception can be obtained as to the limitations of these spaces. Since the fascia envelops the superficial masticatory muscles, the buccinator muscle and the salivary glands, the compartments formed have received similar names. The fascia which covers the buccinator muscle is called the buccopharyngeal. This fascia is actually distinct and firm only along the posterior border of the buccinator muscle. There by its firm attachments to the periosteum of the mandible slightly anterior to the angle of the jaw it forms a compartment which limits infections of the body of the mandible from extending backward.

The fascia which envelops the superficial masticatory muscles is divided on their anterior surface by the zygomatic arch into two parts; the parotideomasseteric and the temporal fascias. The temporal fascia springs from the superior temporal line above and after slitting into two layers, extends downward to become attached to the zygomatic arch on two planes. The deeper layer forms the outer covering for the temporal muscle and thus with the skull as a medial boundary, creates a deep temporal space. The two layers and their attachments form the superficial temporal space. These two layers fuse and again pass downward on the anterior surface of the masseter muscle to fuse in the neck with the cervical fascia. This temporal fascia, therefore, forms the anterior boundary of the masticator space and at the same time the posterior boundary of the parotid space.

The parotid space, or the compartment in which the gland is enclosed is formed internally by the fascia overlying the masseter muscle and externally by a thick fascia which originates from the zygomatic arch and extends downward to fuse with the superficial layer of the deep fascia in the neck. The external layer sends numerous septa into the gland substance and thus associates it with the capsule. Anteriorly and posteriorly these fascias fuse to complete the space.

SOURCE AND TYPE OF INFECTIONS

Infections gain access in general to the face and cranium by two pathways; (1) by means of preliminary trauma which not only devitalize tissue and provide a rent in the protecting skin but actually carry the bacteria into the wound; (2) through small cracks or openings in the skin itself, by means of which streptococci and staphylo-

cocci as well as contagious organisms gain entrance. In a few instance as, for example, parasites, the infections gain entrance by some other portal. Glandular enlargement and suppuration are in reality a secondary infection as they are the result of bacteria being deposited by the lymph vessels from a primary focus.

The various types of infection can best be discussed by describing particular known diseases. Perhaps the most common infections of the head are those in which staphylococci enter small cracks or infect hair follicles or blackheads. These result in furuncles and boils. They of themselves are of small concern but when the surrounding tissue becomes involved in the form of cellulitis, particularly when they are situated about the nose and upper lip, they present a most grave problem and prognosis. For it is in this situation that thrombophlebitis occurs in the facial vein with a reversed current carrying bacteria into the cavernous sinus. This cellulitis, once it develops, must be differentiated from erysipelas, but this is usually easy because its original site is lower down in the face, and it has a deep brawny edema without definite outline and much pain or tenderness. Treatment of this condition should start conservatively. The pustule or furuncle should never be tampered with or squeezed. Wet dressings should be used in early cellulitis. Once however, marked reaction and swelling are apparent, a small incision should be made to evacuate the collected exudate. If the infection continues and a thrombophlebitis is assuredly present, ligation of the angular vein may be done. However, the use of conservatism plus the occasional use of radium packs and *x*-ray irradiation seems the advisable procedure. Infections of hair follicles in the scalp, particularly in elderly people who are weakened by some systemic condition, often become serious problems. The occipital region is the site most commonly involved. The ease with which the infection spreads soon allows a small furuncle to develop into a huge carbuncle. This carbuncle is typical in that it involves the tissues down to the muscle and its extension is only to contiguous tissues. This knowledge is important in the treatment for if surgery is to be employed all the infected tissue must be removed by a circumscribing incision. This operation must take out all tissues down to the muscle. The use of foreign proteins such as horse serum and boiled milk are of great value when conservative treatment is undertaken. The technique of applying them is the same as used in local injections with bacteriophage. This will be described later. Boils of the lower lip are not considered so dangerous as they rarely cause any involvement of the venous flow. They do tend to cause involvement of the submental and submaxillary glands which may need to be incised. Their treatment then is early conservatism plus drainage when the infection becomes localized.

Erysipelas with its red flush, raised irregular edge enclosing islets of normal skin and usually with blisters on the inflamed area is a frequent finding. This disease is caused by a highly contagious bacteria, the Streptococci erysipela, gaining admission into the skin itself through some abrasion or crack. When typical, this raised indurated area takes on the shape of a butterfly with the nose and the area between the eyebrows forming the body and extensions on the cheeks, forehead and about the eyes forming the wings. It may be unilateral. The eyelids often tend to become markedly swollen. When the lids and forehead are involved, suppuration frequently occurs. This exudate tends to burrow into the adjacent tissues and as its progress upwards is limited by the close attachment of the frontalis muscle to the overlying skin and by the attachment of the galea aponeuratica along the superior temporal line it tends to extend laterally into the superficial temporal space so that in many cases counter drainage must be carried out as far back as the auricle. The treatment of erysipelas is still varied. Specific antitoxin in 10 c.c. doses should be given intramuscularly for six days unless the temperature breaks. The face should be

covered with warm magnesium sulphate or boric acid compresses. Ointments should be used on the lips and nose to prevent cracking and the general health should be stimulated. *X*-rays and the ultra-violet lamp have been applied directly to the local lesion but have not given very startling results. The general health must be carefully observed and protected. Abscess formations must be watched for and drained.

Another fairly common infection is that where the lymphatics of the dermis are involved. This is called impetigo contagiosa. It is characterized by scab-like lesions which are readily transplanted by scratching. These lesions should be removed with a scalpel or forceps, the tissues washed with green soap and then either painted with iodine or covered with ammoniated mercury ointment.

It is not possible in this short paper to discuss such infections as lupus, tuberculides, primary, secondary and tertiary syphilides, and actinomycosis, but it is well to remember that they all occur. They often spread rapidly and are not usually limited by fascial planes. It is also well to remember that actinomycosis is excellently treated by radium. Acne and tinea occur but they are dermatological problems.

Inflammation of lymph nodes which may result in abscess formation is usually secondary to some septic focus. Those most commonly involved are the preauricular glands found over the parotid, the occipital and the submental glands. Conservative treatment is best and resort to surgery should not be done until definite localization has occurred and pus is obviously present. This can be determined by a softened area and the presence of fluctuation. Drainage through a small incision as near as possible to a normal skin fold will usually suffice. It is always well to search out the primary focus and treat it.

Acute suppurative parotitis is a severe and grave condition accompanied by great pain and marked swelling, and later edema of the eyelids. This pain is due to the dense fibrous covering of the gland which so completely walls it in that even fluctuation can not often be detected until death from sepsis may occur. In debilitated patients it may be a bilateral infection and then it has a grave prognosis and is usually a terminal event.

Infections of the parotid gland may result from the obstruction of its duct by a calculus or edema or more frequently as a spontaneous complication of operation. The gland may also be infected by rupture of an abscess in an adjoining fascial space either deep or lateral to it. Why infections occur in the parotid glands as a complication of operation is still unknown in spite of the various theories that have been advanced. However, most authors agree that bacteria enter the gland either by passing through Stenson's duct or through the blood stream.

This condition usually occurs in patients who become markedly dehydrated, seriously ill and have poor oral hygiene, following severe abdominal and genitourinary operations. It is prone to follow a dry mouth, the result either of improper fluid intake or the drying up of salivary secretion as a result of drugs.

The diagnosis is usually easy because of the severe pain and swelling and the characteristic edema of the eyelids. However, early in the disease, abscesses pointing near the gland from surrounding spaces must be ruled out for rupture of an abscess, either in the masticator space which is posterior to the gland or the rupture through into the gland of a peritonsillar abscess which points ordinarily in the lateral pharyngeal space, may simulate it.

Prevention of this condition should be the goal of all surgeons and following operations measures which aim to stimulate salivary secretions should be undertaken. Frequent mouth irrigation, the use of chewing gum, rock candy and all day suckers are of great value.

However, once the diagnosis has been made, active treatment must be instigated. Hot or cold applications are advocated depending on which one is best tolerated by the patient. Conservatism in the first

few days seems indicated. *X*-rays and radium packs are now accepted treatment during this period and probably afford more relief and result in more cures than any other method. If, however, on the third day definite improvement is not noted, drainage is imperative. The technique described by Blair, although radical, is adequate. The incision "starts two centimeters in front of the ear and then downward to behind and below the jaw. A flap of skin and superficial fascia is stripped off the whole gland and its parenchyma punctured and torn in numerous places." The gland substance should never be cut with a knife as the facial nerve would be injured. The deep portion of the gland and its posterior surfaces can be exposed by elevating the lower pole.

Wounds of the face and scalp, when they involve the deeper layers, tend to become infected. This infection is then limited only by the facial or muscular attachments. Incisions to drain suppurative accumulations should parallel their limiting attachments. Deep wound infections of the scalp tend to extend beneath the galea and point posteriorly along the superior nuchal lines because their lateral extension is limited by the attachment of the galea to the superior temporal lines.

A wound infection or a ruptured abscess in the superior or deep temporal space will usually point just above the zygoma and incision should be made at this point. When the infection extends downward into the masticator space or when this area is primarily involved, pointing occurs at the anterior border of the muscle and this region should be used for drainage.

In the description of the treatments used in the various infections discussed, bacteriophage has not been mentioned. This is because its place has become so important in the treatment of furuncles, boils and carbuncles of the head that it deserves special space. MacNeal has contributed much to the action and uses of bacteriophage and is now even more enthusiastic. He believes from his experience that all furuncles and carbuncles of the head due to staphylococcus should be treated with bacteriophage routinely and that surgical incision should be delayed until it has been given a trial. It is well to remember that if this form of treatment is to be used it must be done thoroughly with the correct phage or no benefit can be expected.

The procedure that has proved most successful is, (1) to inject 2 c.c. of the bacteriophage intravenously each day; (2) to needle the area around the furuncle or carbuncle with enough bacteriophage to blanch the skin at each injection; and (3) when the infection has pointed and opened to actually flush through this opening from the outside areas large amounts of the bacteriophage. A stock staphylococcus phage is used until the specific one is obtained from cultures taken when the patient was first seen.

SUMMARY

1. Mention is made of the historical knowledge of head infections.

2. The anatomy of the vascular system with its abnormalities is described.

3. The attachments of muscles and fascia of the head are described and the effect they have on limiting the extension of infections is discussed.

4. Common infections are described and their treatment outlined.

5. Bacteriophage in the treatment of head infections is described.

REFERENCES

Bailey, H. Ligature of the angular vein as a preventive measure in facial carbuncle. *Surg. Gynec. and Obst.*, 46: 565, 1928.

Blair, V. P. and Padgett, E. C. Pyogenic infection of the parotid glands and ducts. *Arch. Surg.*, 7: 1, 1923.

Coller, F. A. and Yglesias, L. Infections of the lip and face. *Surg. Gynec. and Obst.*, 50: 277, 1935.

Cunningham. Textbook of Anatomy. Baltimore, Wm. Wood & Co.

Garrison, F. H. History of Medicine. Phila., W. B. Saunders & Co.

MacNeal, W. J. The use of bacteriophages in wound infections and in bacterenias. *Am. Jour. Med. Sc.*, 184: 805, 1932.

Mitchiner, P. H. Infection of the face and lips. *Practitioner*, 136: 367, 1936.

Singer, E. Fasciae of the Human Body. Baltimore, Williams & Wilkins, 1935.

MALIGNANT TUMORS OF HEAD

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KNOWLEDGE of the nature and characteristics of malignant lesions of every kind has steadily increased as the pathologists press forward in research, and progress in the treatment of these lesions should follow the increase in definite knowledge of their nature and characteristics.

Ever since Broders established his classification of tumors into Grades I, II, III and IV on the basis of the degree of differentiation it has been possible for the practitioner in charge of cancer cases to know, *before beginning treatment*, (1) what kind of a tumor it is, (2) what is its degree of malignancy, and (3) whether it is radiosensitive or radioresistant.

This definite knowledge should put an end to the automatic application of one kind of treatment for all cases. Obviously, the radiosensitive tumor (Grade III or IV) should not be excised by scalpel and the radioresistant tumor (Grade I or II) should not be treated by *x*-ray or radium.

In our opinion the office use of the microtome represents the greatest step forward in the treatment of cancer that has been taken in a decade. As proved by the work of William C. MacCarty, of the Mayo Clinic, this procedure in immediate diagnosis is so perfected that within five minutes from the time the biopsy specimen is taken the tissue can be frozen, a stained section placed under the microscope, and the pathological diagnosis and classification definitely established.

Since the announcement of this important advance the writer has had in his office a microtome and a tank of carbon dioxide for the making of frozen sections. By the biopsy electrode it is now a simple matter to remove a cube of tumor tissue, and I have yet to see any unfortunate results attributable to biopsies made in this way. It does not require a great deal of pathological knowledge or experience to be able to distinguish a highly differentiated adult, squamous, radioresistant tumor from an anaplastic, radiosensitive tumor (Fig. 1).

Fortified by full knowledge of these recent advances in cancer technique, the surgeon will lose no time in referring for irradiation every case of anaplastic, radiosensitive tumor, except the basal cell epitheliomas. He will follow this irradiation with electrosurgical removal of the residue of malignant tissue, should any remain.

Since the fully differentiated, adult, squamous cell carcinoma is radioresistant it must be given repeated doses, or a cauterizing dose, which causes it to break down and slough. By electrosurgery, the surgeon can destroy and remove in a single treatment, covering only a few minutes, a lesion the successful irradiation of which would require many weeks.

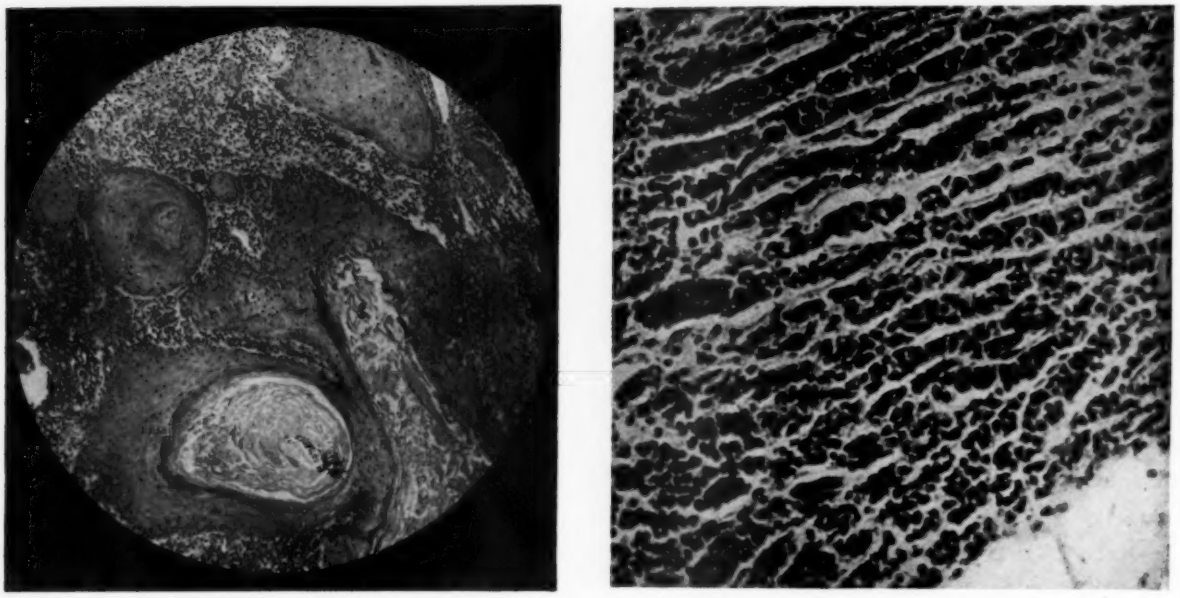
Mindful of the subject assigned him, "Malignant Tumors of the Head," the writer would, first, indicate briefly certain facts which bear upon the applicability of electrosurgery to office cases.

Because each of the three currents is easy of application and is clean in its results, each has an especial usefulness in office work.

The lightest current, the monopolar or desiccating, is the one most often used. For the removal of angiomas, papillomas, warts, moles, pigmented nevi, fibromas, leukaplakia, polypi, epuli and other blemishes this is of all treatment methods the one of choice.

Removal can be begun and finished in a single application.

In proper use, under local anesthesia, penetration, it is so completely under the control of the trained operator who knows his machine and the characteristics of the



A B

Fig. 1. Microscopical pictures illustrating difference between A, Grade I fully differentiated, squamous cell carcinoma, and, B, Grade IV, anaplastic carcinoma.

desiccation is painless; its sealing of superficial blood vessels prevents hemorrhage and produces a minimum of secondary reaction. There is, therefore, a superior cosmetic result with none of the scarring which follows scalpel excision. Because the neoplastic tissue is removed as a dead mass, however large or small it may be, the possibility of recurrence and metastasis is lessened.

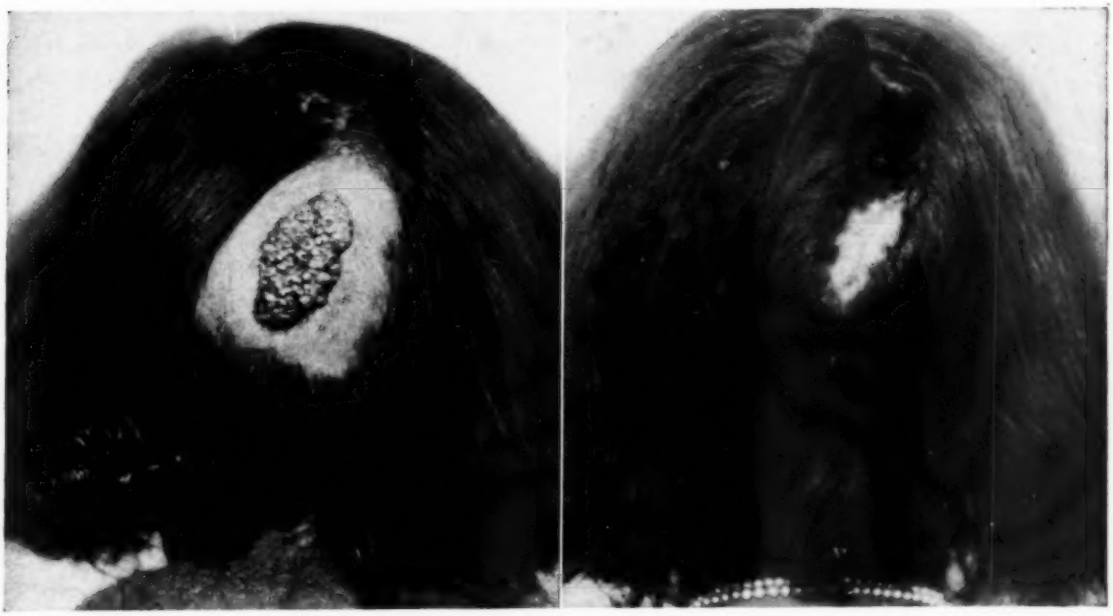
For a long time the teaching was that such superficial lesions, such "blemishes," should be let alone until they became active. Since the perfection of the surgical use of the monopolar current, however, it is clear that by removal of "precancerous conditions" it is possible to prevent their becoming active.

The second electric current used in surgery is the bipolar or coagulating current. In tissue treated by this current the cell outline is lost, the elements being fused into a structureless, homogeneous mass. The result is coagulation necrosis. Although this current is applicable to lesions calling for more extensive destruction and a deeper current that it may be used in office routine for the treatment of many cases which would otherwise need hospitalization.

The third electric current used in surgery is the cutting current. Its perfection was reported by the writer to the Surgical Section of the New York State Medical Society, meeting in Rochester, in April, 1924.

We may say here merely that the qualities inherent in the other currents—the monopolar or desiccating and the bipolar or coagulating—give to the patient treated by the cutting current, the endotherm knife, a great measure of protection against shock, against hemorrhage and against the threat of recurrence or metastasis. It seems scarcely necessary to emphasize the fact that these qualities very especially adapt electrosurgery to office use. Let me illustrate by the case of M. M. a patient of the Cornell Clinic.

Case I. The patient was a young woman of twenty-five years who was suffering from a cerebelliform melanoma of the scalp (Fig. 2A). The lesion was growing and its immediate



A B

FIG. 2. A, cerebelliform melanoma of scalp excised by cutting current; B, soft pliable healing. No apparent metastasis or recurrence in seven and one-half years.

FIG. 3. Photomicrograph showing widespread distribution of melanin granules.

excision was advised. Melanoma is one of the most virulent and highly malignant lesions, but as it is known to be radioresistant, irradiation should not be prescribed. The choice of means of removal lies between the scalpel and the endotherm knife or cutting current. Any surgeon who has had experience with scalpel excision of melanomas will wish to use the other method.

Fig. 4.

Fig. 5.

Figs. 4 and 5. Fibro-angiosarcoma of scalp before excision by electrosurgery.

On March 20, 1924, under local anesthesia, the cutting current excised the lesion without hemorrhage. The sutured wound healed by primary union and the result was a smooth, pliable scar (Fig. 2B).

Examination established the diagnosis of cerebelliform melanoma of the scalp (Ewing). The photomicrograph of the lesion (Fig. 3) shows widespread distribution of melanin granules.

The patient lived more than seven and one-half years and died in one of the larger hospitals of the city following a pneumothorax operation for "pulmonary tuberculosis."

The intense heat produced by the resistance of the tissues to the passage of the many oscillations of high frequency current sterilizes the lesion. After its removal a thin, healthy film of coagulated tissue remains. There is reason to believe that the gradual absorption of this remaining bit of coagulated tissue which goes on in the sloughing process acts as a foreign protein to the reticulo-endothelial tissue and thereby accounts, in some measure, for the feeling of general well being which the patient experiences immediately after the use of electrosurgery. It would be difficult to prove this connection but the writer has so often observed it he cannot consider it accidental. It presents itself as a clinical fact offering a field for scientific investigation.

Readers of the American Journal of Surgery will recall that in Report No. 34, issued by the British Ministry of Health on "The Late Results of Operation for Cancer of the Breast," it was pointed out that 90.1 per cent were alive ten years after operation if growth had been limited to the breast, and that 91.3 per cent were dead in ten years if the axillary glands had become involved before the date of operation. May I here make mention of a case of fibro-angiosarcoma of the scalp which, excised by electrosurgery, shows no evidence of

recurrence almost twelve years after operation although there was considerable glandular enlargement at the time the case was first brought to our attention. In our opinion, report of this case has place in this paper although it was treated in the City Hospital and not in the writer's office.

Case 11. At birth the child, R. A., had shown nothing abnormal except a black mark about 2.5 cm. in diameter, on the back of the scalp.

At the time the writer first saw her the child was five years old and the scalp growth was as illustrated in Figures 4 and 5. Glands of the neck were enlarged. There was no apparent tenderness, the lesion was movable within the normal range of scalp mobility and did not appear to be attached to the structure of the cranium. *X*-ray pictures showed no destructive or productive changes in the vault of the skull; the inner and outer tables were all of normal thickness and there was no evidence of pressure. The heart and lungs were normal, as were the abdomen, extremities and reflexes.

On June 27, 1925, the growth was excised by the cutting current with but little hemorrhage and no surgical shock. The skin over the

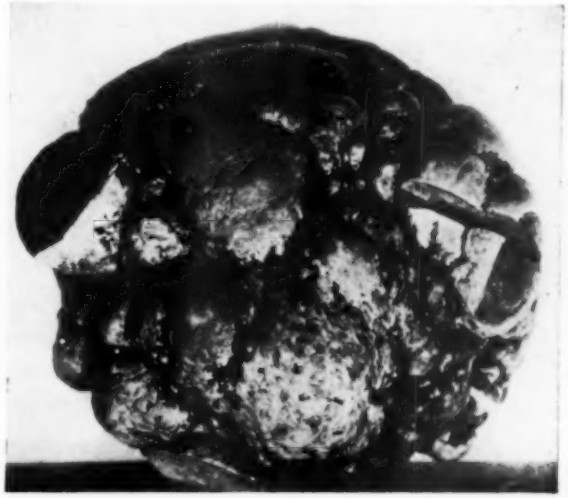


Fig. 6. Growth excised in one piece by cutting current.

glands in the neck was then undermined with the cutting current, and the glands themselves were coagulated by the bipolar current and left in situ to be absorbed.

Fig. 7. Appearance of patient almost twelve years after removal of fibro-angiosarcoma of scalp.

The lesion had been treated with radium for more than a year but no one had attempted removal by the scalpel.

Since the operation there have been frequent examinations, but never any evidence of metastasis or recurrence. The patient is now

a normal, happy school child, as shown in Figure 7.

Detailed mention of this case is important in connection with any discussion of tumors of the head for more reasons than have yet been given. It illustrates the fact, not well enough known, that not every enlarged gland in a case of cancer is malignant. So often has this fact been proved by the microscope that the writer has discontinued the routine bloc dissection as unscientific and unwarranted. If glands are not malignant their removal is not necessary. If they are malignant, their removal does not seem always to prevent recurrence. The presence of enlarged glands, therefore, should not of itself preclude operative interference by newer methods.

SUMMARY

This article establishes the relationship which knowledge of the nature, characteristics and treatment of malignant lesions should bear to the forward steps of pathologists' research and to the institution of treatment. MacCarty's work on the differentiation of tumors together with the office use of the biopsy electrode and the microtome, has made possible the practitioner's classification of tumors and the choice, before treatment is begun, of the proper measures to be taken in each individual case. The nature of the three high frequency currents employed in electrosurgery, their advantages and their separate applicability to office procedure in different grades of malignant tumors is outlined, and 2 case reports cited.

ANGIOMATA OF SKELETAL MUSCLE

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ANGIOMATA of the muscle are considered rare tumors; they have been found in the bones in only 10 per cent of autopsied material. The abundance of recent reports on angioma of the muscle suggests that they might be more common than the early reports would indicate.

Angioma or hemangioma is an abnormal dilatation or overgrowth of blood vessels. They are considered by some to arise from lymph spaces and that the presence of blood in them is more or less accidental.

There are considered to be three types of angiomata: (1) simple, (2) plexiform, and (3) cavernous.

The simple angioma is a congenital dilatation and overgrowth of capillaries. Its independent existence is denied by some authors who maintain that they are simply a step in the development of the cavernous type.

Plexiform angiomas are overgrowths of capillaries and venules in length and thus pile up nodules of vessels which may acquire considerable size. They do not destroy other tissues.

The cavernous type is an overgrowth or hyperplasia of existing vessel walls with a gradual disappearance of the intermediate tissues through atrophy, thus forming cavities.

ETIOLOGY

Of the many theories the following two receive the most support. Angiomata are considered to have their origin in a congenital anlage which after a trauma begins to proliferate and develop into a tumor (Ribbert) or existing vessels dilate and proliferate after a time, some of the walls becoming atrophic, disappear and allow the sinuses to develop (Virchow). Trauma is considered as the starter in both theories.

All are agreed that they are congenital. Fitzwilliams found that 83 per cent were present at birth, 12 per cent appeared during the first three years of life; 16 per cent volunteered a family history.

PATHOLOGY

These tumors are usually described as being bluish-red to yellow in color. They may be soft or quite firm depending upon the ratio of vascular to fibrous tissue. The tumor may be circumscribed or diffuse. If the latter, muscle invasion will be observed even to the extent of replacement. Nerves and blood vessels may also be invaded.

Microscopically, the tumor is composed of numerous blood filled spaces lined with endothelial cells. These spaces are supported by a variable amount of connective tissue, the amount determining the consistency of the tumor. Thrombosis of the spaces frequently occurs and is followed by organization and the further formation of connective tissues. This process may become extensive enough to halt the progress of the tumors. Myelated and unmyelated nerve fibers sometimes appear in the tumor.

SYMPTOMS

Pain is the chief complaint and may be of three types: (1) a feeling of fullness which is probably due to engorgement and can be relieved by elevation of the leg; (2) a radiating pain similar to a root pain and is probably caused by pressure on or infiltration of the sensory nerves; and (3) sensitiveness to touch. This type of pain is

explained by irritation of new nerves which are sometimes present within the tumor or to the presence of angiolithic concretions.

Pain is more prominent when the tumor is in muscles that lie close to nerves as in the thin muscles of the extremities than in the thicker muscles of the trunk and neck. It may be present only when the muscle is being used and absent when the muscle is relaxed. There may be numbness or formication.

Another symptom is impairment of function. It may vary from slight limitation of motion to a contracture, or from slight weakness to almost complete loss of function. This may be due to the pain or physical presence of the tumor which prevents contraction, or from weakness because of destruction of muscle tissue and replacement by tumor tissue and fat.

Swelling is the only sign of which the patient complains. This may be ill-defined and appear at any time and it may remain stationary or gradually increase. Sometimes it may be noticeable only after prolonged use of the involved muscles and disappear after rest. Then again the swelling is only found at time of operation. It is good to bear in mind a sign Davis called attention to, i.e., varicose veins in a child should suggest a deep seated hemangioma. One of Kidner's cases had associated varicose veins.

The roentgen ray usually brings out only a soft tissue swelling. Occasionally the large blood spaces give the appearance of gas in the tissues. Occasionally there may be the characteristic angiolithic concretions (Ruggles). They consist of a thin shell with an irregular center. They are thought to represent calcified thrombi.

The diagnosis is seldom made preoperatively. A hemangioma should be considered when the tumor decreases in size on elevation, if normal blood is withdrawn at aspiration and the tumor fills again within a very short time, and if the *x*-ray film shows the millet seed concretions. The history of the case, its time of appearance and duration, early lack of symptoms, and their type as given should be taken into consideration.

Arteriography has been of no value to us either in diagnosis or in outlining the course of treatment, because there are no afferent or efferent vessels.

TREATMENT

Excision was considered the treatment of choice in both of the cases herewith reported as well as the 2 cases previously reported. Excision is relatively easy when the tumor is small but it presents great difficulties in the larger tumors which involve a considerable portion of a group of muscles, nerves or blood vessels. In such cases other methods may be employed to save the affected limb from amputation. Compression of the angioma, ligation of the arteries which nourish the tumor and treatment with *x*-ray or radium may be tried.

Case I. As this paper goes to press a girl of about seven years of age entered the clinic because of an ulcer on the mid-third of the anterior surface of the tibia following a bruise against a rocking chair. She gave the history of having a tumor the size of an orange in this area since birth which her doctor cured by means of a pressure bandage. There was an area around the small ulcer about 3 inches in diameter which contained little subcutaneous fat and the skin contained fine red spots suggestive of a hemangioma. A biopsy proved this to be the case. It did not seem to penetrate the vaginal fascia. Reports of similar treatment of muscular angioma, however, are not so favorable. Ligation is not considered favorable as there is no single vessel nourishing the tumor. Radium or deep *x*-ray therapy are most promising. Both have helped to reduce the size of the tumor.

The histories of 2 patients with angioma of voluntary muscles are given to emphasize the characteristic symptoms of the disease, to stress the functional disability and the difficulty in overcoming it.

Case II. T. H., aged fifteen years, presented herself in August, 1935, because of a painful mass, of eight years duration, in the back part

of her left leg above the ankle. At the age of seven years, the patient jumped over a fence, fell and twisted her left leg. The leg hurt continuously for several days, then irregularly for six months when a mass appeared in the calf. This mass gradually increased in size and extent for two years. Since this time it was stationary but would swell when the patient walked excessively. She stated that she lost many nights sleep because of the pain in her legs. The leg was less painful when the patient was at rest, and quite painful for hours upon lying down after exercise.

Physical examination revealed nothing of interest except for the swelling in the lower left leg posteriorly. The narrowness beneath and the curve of the Achilles tendon was obliterated by a tumor mass more or less firm, quite tender to touch, and about 20 cm. long and 10 cm. wide. It seemed to be a part of the gastrocnemius, and the Achilles tendon.

This mass was explored October 24, 1935, through an incision 15 cm. long centered over the posterior surface of the leg 6 cm. above the os calcis. A firm, vascular grey pink irregular tumor 7 by 3 by 1.5 cm., which seemed to arise from the anterior part of the gastrocnemius muscle with downward extension and was adherent to the Achilles tendon, was excised. This was difficult because of the vascularity and the diffuseness of the tumor.

The wound healed primarily and the patient was discharged.

Pathological Report. "Cavernous Hemangioma." "The tumor mass has yellow to orange colored tissue containing numerous small blood spaces. It has no capsule.

"The microscopic sections shows a background of muscle heavily infiltrated with fat. There was also focal areas of round cells.

"Scattered about are large blood filled spaces lined by endothelial cells. These are numerous, and in areas reach large proportions. These are also connected by long slender channels from one space to another.

"The surrounding musculature as a result has undergone atrophic changes, is a pale pink in color, the individual muscle bundles of a given area being fragmented and amorphous in appearance. In contrast an area immediately adjacent may have few bundles of muscle in a fairly good state of preservation."

She continued to have pain and was developing an equinus deformity, so she was readmitted to the hospital March 31, 1936 for further surgery.

The same incision was used. At the upper end of the tumor three branches from the posterior tibial artery were found to enter the tumor mass. A tumor 5 by 4 by 3 cm. was excised from the lower end of the gastrocnemius. The flexor hallucis longus was also found to be involved.

The wound healed primarily.

It was thought at the time of the first operation that all the tumor tissue was excised. This case raises the question of a malignant nature in that it tends to recur locally.

H. B., colored, aged seven years, came to the clinic July 29, 1935 because of a limp of nine months duration. She complained of pain over the back of the knee when touched. Physical examination was negative except for a moderate flexion contracture of the right knee. Inspection revealed no tumors. The posterior surface of the lower thigh and popliteal space was so sensitive that the child screamed when touched even lightly. The temperature was 99.5°F.

Radiogram showed irregular calcareous shadows in the soft tissues of the leg just below the knee joint. Nature—angioma? malignancy?

On February 24, 1936, under anesthesia, one could feel three distinct tumor masses, the first posterior to the upper end of the tibia, the second in the muscle tissue apparently in the lower end of the inner hamstrings, and the third about midway along the thigh posteriorly apparently in the muscle tissue. The first tumor involved the posterior tibial nerve. To remove it would have meant to remove the nerve. Cutting into it longitudinally the knife grated because of the calcareous material. The second tumor was in the lower end of the semimembranous muscle. It was resected and the healthy distal end of the muscle sutured to the semitendinosis. This tumor was firm, grayish-pink, quite vascular and 8 by 3 by 2 cm. in size.

The pathological report was essentially the same as for the other case.

These 2 cases are of interest because the symptoms of the one are typical of an angioma history and the second case because

of the concretions which brought the diagnosis of angioma into consideration.

SUMMARY

Functionally, angiomata may be considered as malignant vascular tumors. Pathologically, there are simple, plexiform, and cavernous types. Pure types of the first two are not often seen, which suggests to some that they are a stage in the development of the cavernous type. The symptom of pain, and the sign of swelling are the patient's complaints. The treatment of choice is radical resection. In the extensive ones, *x*-ray and/or radium application may retard the growth sufficiently to avoid amputation or prolong the time before it becomes necessary.

REFERENCES

Bailey, P. Cavernous hemangioma of vertebra. *J. A. M. A.*, 92: 1748, 1929.

Bucy, Paul and Capp, Charles. Hemangioma of bone. *Am. Jour. Roentgenol.*, 23: 1, 1930.

Burman, M. and Milgram, J. Hemangioma of tendons and tendon sheaths. *Surg. Gynec. and Obst.*, 50: 397, 1930.

Davis, J. S. and Kitlowski, E. A. *Arch. Surg.*, 20: 39, 1930.

Ireland, Jay. Hemangioma of the vertebra. *Am. Jour. Roentgenol.*, 28: 376 (Sept.) 1932.

Johnson, H. Calcifying hemangioma. *J. A. M. A.*, 90: 1108, 1928.

Kidner, Frederick C. Diffuse cavernous angioma of the leg. *Surg. Gynec. and Obst.*, 63: 647, 1936.

Kleinberg, S. Angioma of the leg. *Ann. Surg.*, 91: 317, 1930.

Ruggles, H. E. Calcification in angiomata. *Am. Jour. Roentgenol.*, 6: 512, 1919.

Thomas, H. B. Angiomas of skeletal muscle. *Am. Jour. Surg.*, 31: 354, 1936.

Traub, E. F. Should vascular nevi be treated? *Arch. Ped.*, 50: 273, 1933.

INFECTIONS OF NECK*

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INFECTIONS in the neck occupy a considerable proportion of the office time of the practicing surgeon. Between the skull and the scapula, or between the mandible and the clavicle, are contained much concentrated anatomy and in this area are seen inflammatory lesions that may be occasionally serious, but always painful and inconvenient.

In the cervical region, there is a great group of rather routine lesions, and a few unusual ones. But on the surgeon's skill in diagnosis and treatment depends not only the health, but also the appearance of the individual.

Aside from all matters of safety and comfort, the girl will forever appreciate the doctor who leaves her neck with a small and inconspicuous scar, and will frequently blame the surgeon instead of the disease, if the scar happens to be wide or ugly.

Of the superficial group of infections, impetigo is rightly due to the dermatologist, but often comes to the surgeon, and is of diagnostic importance. The scattered appearance of the honey colored crusts, and the chronic, intermittent story, usually are typical. It can be easily cured by detailed cleanliness, and some mild antiseptic as the ammoniated mercury ointment of the U.S.P.

Erysipelas should be relegated to the same specialty but even in textbooks, the disease is given to the surgeon. This has considerable morbidity and mortality. It usually starts around the orifices; usually occurs in persons under par generally; is associated with high fever, and tends to run a spontaneous course. Specific anti-streptococcus serum is invaluable in the treatment, but must be given in adequate doses and repeated till effects are obvious. Ultraviolet light, given long and often enough to produce a mild erythma, is useful. Local lotions and applications, we keep as simple as possible.

The ordinary furuncles and boils are treated as they would be elsewhere, with this emphasis; be entirely gentle in the manipulation of inflammatory lesions about the face and neck. Many of the larger boils can be evacuated gently through a small incision, and under the influence of wet dressings will heal with small scars. Teach your staff and your patients not to squeeze boils about the neck.

Intermediate between this superficial group of infections, and the deeper, is a more dangerous one; Ludwig's angina, a "phlegmon" or septic adenitis. This is a diffuse inflammation of both the superficial and deep tissues of the neck, following the fascial planes, usually after some inflammation about the throat or mouth, or some slight abrasion of the skin. The tissues rapidly become boggy, edematous, thickened, in the beginning without the formation of real pus. The patient shows a high fever and signs of general prostration. In a rather high percentage of cases, there is a fatal termination.

The condition was first described a hundred years ago by D. Ludwig and cases occur frequently enough so that every active surgeon sees one at intervals.

Ludwig's angina is, therefore, a difficult and dangerous disease. Be on the watch for it and give your prognosis accordingly.

The term probably covers a group of infections which may extend from the mucous membranes, deep along the lymphoid tissue of the pharynx, and produces a diffuse swelling and hypertrophy of all the lymphoid and areolar tissue of the neck with almost explosive suddenness.

With other cervical infections, one can temporize, while considering diagnosis and treatment. But in true Ludwig's angina,

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the patient is often better or worse before cultures and detailed laboratory reports can be obtained. Here the surgeon must depend on his own clinical observation guided only by his training and experience.

Treatment is notoriously difficult. Entire conservatism, with the application of wet dressings, poultices or local applications, often leaves the patient increasingly toxic, and he may die from extension into the mediastinum or from pressure on the deeper structures of the neck.

Incision and drainage usually fails to find definite pus, and the surgeon rests in the hope that the release of pressure on the fascia may accomplish some good, or that the outlet for serum may allow the pus to drain if, as and when it forms. But the decision for or against open surgery must be made quickly.

Carbuncles, of the deeper lesions, are most typical on the back of the neck, where the thick layers of fascia subdivide the subcutaneous and ligamentous layers between the spine and the occiput.

The clinical history usually begins with a small abrasion, a boil or a furuncle, which is rubbed by the collar or squeezed manually, and failing to resolve, becomes increasingly inflamed. By the time the patient reaches the surgeon, the infection has spread wide beneath the exposed area, and has burrowed deep in the fascial planes on the posterior aspect of the neck.

Diagnosis is usually obvious. But be sure of complications. Work the case up thoroughly before you start and make sure that the patient has not some systemic disease as well. Occasionally, the presence of sugar is discovered only after the lesion fails to heal, to the discomforture of both the patient and the surgeon.

The conservative treatment of carbuncle is worth trying in selected cases. Short, fairly frequent, *x*-ray treatments, with a low voltage, i.e., from 60 to 80 kilovolts, and a light aluminum filter, may effect results, with a minimum scar. With this, or as a means in itself, you may use nonspecific protein therapy, with typhoid vaccine or sterile milk injections. Avoid the ointments and oily applications. Saline dressings, or hypertonic solutions, or the mixture of glycerine and magnesium sulfate give great relief, and are worth the trouble they cause.

But, don't be too set in your scheme. If this does not prove effectual in a few days; if the lesion is not definitely improving; change your mind and turn to surgery.

Surgery of a carbuncle should be radical. Use anesthesia enough to accomplish what you have to do. Local anesthesia is difficult and may spread infection. General, such as nitrous oxide or ethylene, is easier for patient and surgeon. Skin preparation should be ample. During the stage of healing, you will bless the wide area of shaving.

Incision should be crucial and should extend to normal tissue on all sides. Dissect back the corners of the flaps, so that the infected tissue is exposed and drained from beneath.

Probably some of the flap will slough off, but the main portion of it will be saved, and you will be thankful for this in the weeks you are waiting for the lesion to heal.

Reserve the operation of complete excision for those very toxic cases, where you must get rid of the infection quickly.

So, go wide and deep, and dissect with scissors far enough to lift the flaps free, so that you can see normal tissue. Do it at the first operation and save yourself a second trip. Then pack the flaps wide open with vaseline gauze, or gauze soaked with the 50 per cent mixture of magnesium sulfate and glycerine.

At this stage, large moist dressings give great comfort, or daily applications of ultra-violet light, but keep the packing in, and allow the clean granulations to push it out. Then when the cavity is clean, which may be in two weeks or six, allow the flaps to come together, or even pull them together with narrow strips of adhesive. The scar will look much smaller when you get through than you ever could imagine in the beginning.

Another great group of inflammatory lesions are those associated with diseases of the lymph nodes. The most common one is the mild or more severe lymphadenitis that occurs with a sore throat or an infected

tooth, most commonly in children, but also in adults. These clear up with healing of the primary focus. They require no specific therapy, beyond the local, symptomatic warm, moist applications. Encourage your patients not to rub them with the thousand and one things they read about in the lay press.

Chronic swelling of the glands of the neck, again most commonly seen in children, is generally tuberculosis, whether definitely proved or not. Most of these are probably bovine, through infected milk. Certainly we seem to have seen fewer cases since herds have been tested and milk more generally pasteurized.

These give a clinical history of glandular enlargement after an acute upper respiratory infection, but the glands persist after the infection in the throat has subsided. Then they gradually grow larger over a period of weeks; become moderately tender and painful, and adherent to the skin and underlying tissues. They have a characteristic texture, so that trained fingers may make the diagnosis by the sense of touch.

If the individual gains in weight and strength, the glands may gradually become smaller. If on the contrary, the infection gets the upper hand, the glands will increase in size and even become fluctuant. At this stage, they may be very large, and cause torsion of the head and neck.

These broken down nodules are apt to break to the surface and drain. The period of drainage is long, and the abscess cavity is continually reinfected with the usual pyogenic organisms introduced from the outside.

Treatment of tuberculosis of the lymphatics undergoes periodic changes. Recently Miller and others have advocated again the more complete dissection of the neck. The basic idea seems logical; that by complete removal of the focus of infection before the glands break down, you might remove the tubercle bacillus from the body entirely and prevent infection spreading elsewhere, especially to the lungs. But this operation, if done at all, must be complete, and of course is not an office procedure. The surgeon must know his anatomy, and make a large enough incision to visualize the structures with which he is working. The incision heals with a narrow scar.

But the conservative methods, too, give results. It is argued that this small and usually well controlled site of infection "vaccinates" the body against the tubercle infection elsewhere. Usually the glands gradually do become smaller and usually do not break down.

So, the alternate scheme is to endeavor to build up the patient's general health, with such measures as rest, fresh air, good food, sunshine, or local ultra-violet light. Even then, there may be some small nodules which remain for years.

If fluctuation or suppuration occurs, open and drain through a small incision, or aspirate through a large needle. Aspiration has the advantage of avoiding secondary infection, but it is sometimes impossible even with a good sized needle.

But open before the lesion breaks. This gives you an opportunity to plan the line of incision, so that it runs with the line of fold of the skin of the neck. A spontaneous opening is apt to leave a large and ragged scar which will persist through life.

Any method must control foci of infection. Adenoids and tonsils, or infected teeth must be adequately cared for or removed if advisable.

Remember that the conservative method does not mean sitting back and praying. The regime of forced nutrition must be real. Measures must be planned in whatever economic strata the patient is found. For the maximum result, it is well to keep the patient entirely at rest for the first part of the period of treatment, and restrict activities later till the process of infection is definitely subsiding.

Keep up the patient's morale, and that of the family as well. Better explain to them early that the patient will need observation over a period of months or even years.

But nothing is quite so well worth while. Results can be obtained and the neck left free from scars.

In considering differential diagnosis, Hodgkin's disease is commonly first found in the neck. This usually occurs in young adults; the glands are hard, firm and discreet; there is no adherence to the skin or the deeper tissues, at least in the early stages. Again, the trained, sensitive fingers are most diagnostic.

Lymphosarcoma occurs just often enough to make us suspicious of any chronic lymphadenitis in an adult. Lymphatic leukemia may give its first sign by swelling of the nodes in the neck, and may be in young or old. A swollen lymph node may be the first complaint in a carcinoma hidden away in the inside of the mouth.

Get adequate blood examinations, or excise a gland for pathological examination, if there is any doubt at all. This may save many future explanations, if the clinical course happens to be unhappy.

Actinomycosis is unusual, but must be kept in mind in the differential diagnosis of those non-healing, draining deeper lesions. Make direct smears and see if you can find the characteristic filaments.

Infection in the salivary glands is most commonly that of parotitis in epidemic form, or mumps, which is usually handled by the pediatrician. It is a self-limited disease, and the only difficulties are in the complications.

Septic parotitis is usually found in those individuals who cannot or will not take liquids by mouth, perhaps most often in those postoperative gastric or peritoneal cases where fluids must be given in other channels for the first few days. The best treatment is prophylaxis, by the use of chewing gum. Encourage the patient to use his jaws and stimulate the flow of saliva, even if you do not yet feed him by mouth.

Septic parotitis is not the fatal or dangerous complication mentioned in some of the textbooks. I have observed a number of cases regress spontaneously, or heal kindly after local incision and drainage.

Another site of infection about the neck is inflammation in the cysts and sinuses from branchial cleft remains. These account for a few that cannot be explained otherwise. These branchial cleft structures occur in a diagonal line, downward and inward, from the ear to the sternum. They burrow deep, and if excision is attempted, rather than mere incision of an acute abscess, be ready to follow the tract deep, often between the internal and external carotid arteries, to the deeper layers of the cervical fascia around the pharynx.

Infection untreated in these cysts may give a mass the size of a hen's egg, which on rupture will give a chronically discharging sinus.

Injection of methylene blue is an old and simple trick but one well worth while. It is much easier and simpler to inject the tract first and follow along the line of color, whatever your personal skill in fine dissection may be.

Then the ever recurring differential diagnosis of syphilis must be made in infections of the neck. If the primary lesion is about the lips or face, the regional lymph nodes are in the neck, and will early show signs of enlargement. The primary lesion may be well hidden on the inside of the mouth, or throat, so look closely if the history is subacute and the glands hard. Again this is a bit unusual, but the active practicing surgeon will see one often enough to keep his diagnostic eye open.

SUMMARY

1. Use gentle manipulation and small incisions in treating boils or furuncles of the neck.

2. In carbuncles, if conservative methods do not quickly bring results, use wide crucial incisions with undercutting of the flaps.

3. In chronic lymphadenitis, unless you use wide dissection, adopt a regime of increased general nutrition, and use aspiration or small incisions if suppuration occurs.

4. Watch for the unusual but rapidly developing Ludwig's angina with its poor prognosis.

5. In all neck lesions, make a careful differential diagnosis and use biopsy frequently.

FRACTURES OF NOSE

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THE object of this paper is to discuss in a general way fractures of the nose as seen by the general practitioner, or general surgeon and usually caused by blows, falls, or other less severe traumas—not those severe injuries to the facial bones resulting from automobile, aeroplane, or other bad accidents. Such injuries are in a class by themselves, and should be handled by some surgeon trained and proficient in this type of work. In view of the number of such accidents today it is surprising to know how few general hospitals have an associate competent and able enough to take care of these cases properly. Many of these patients are eventually sent to the plastic surgeons, though they might have been saved this second operation.

In speaking of fractures of the nose we cannot speak of the fractured nasal bones alone but must take into consideration injuries to the other bones which enter into the formation of the nasal arch. It is possible to have a fracture of the nasal bones alone such as might occur if the patient were hit forcibly on the dorsum of the nose with a pointed instrument, thereby causing a central separation of the bones or a lateral depression of one bone. However, in most cases of fractured nose, as referred to by the majority of the profession and many of the laity, there is generally an involvement of the nasal process of the superior maxilla, the lacrimal bone, or the nasal spine of the frontal bone, or some injury to the septal cartilage. It is the involvement of the lacrimal bone and the nasal spine of the frontal bone which causes the severe ecchymosis sometimes seen in injuries involving the nasal arch.

In adults the nasal bones are thick and narrow at their upper extremities, and thin, broad and much exposed to injury at their lower portion. Hence, blows at the base of the nose are more likely to cause a fracture of the nasal spine of the frontal bone, the lacrimal bone or some portion of the anterior ethmoid, whereas blows on the lower two-thirds of the nasal arch usually involve the nasal bones and the nasal processes of the superior maxilla.

Injuries of the nose in children are very important and should not be regarded as trivial. They are important because we are dealing with immature growing bone and cartilage with a highly sensitive periosteum and perichondrium. The nasal bones are not very large in children and as a result are fairly well protected from falls. The septal cartilage takes the greater part of the force of the fall and hence may be bent, broken or torn from its attachment to the nasal spine of the superior maxilla. When this occurs, a hemorrhage may lift the perichondrium and mucous membranes from their attachment to the cartilage and thus seriously interfere with the nutrition of that cartilage. Such a condition is a very serious one and unless taken care of properly and promptly may result in a septal abscess with a partial or complete absorption of the septal cartilage and consequently a deformed nose. These cases are usually brought to the neighborhood doctor with a history that the child was playing tag with the other children and slipped and fell on the curb, the step of a porch or other object which might cause the force of the fall to be delivered on the tip of the nose or in the region of the nasal spine of the maxilla. The child complains that he cannot breathe through his nose and examination by the general practitioner shows a swelling behind the columella-nasi blocking off both nostrils. The skin and mucous membranes covering the anterior por-

tions of the septum are ballooned in such a manner as to press against the inner surfaces of the alae of the nostrils. There

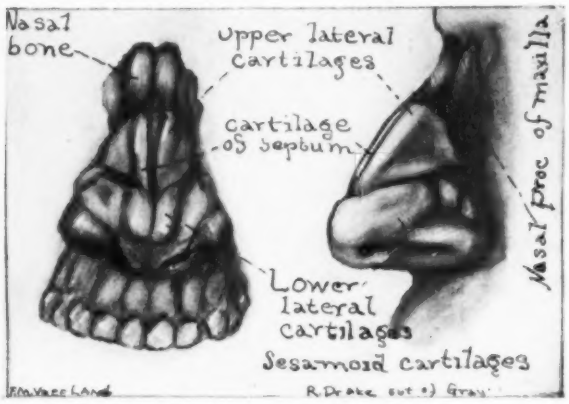


Fig. 1. Anatomy of the external nose.

may be no pain, redness, or tenderness in this area when the case is first seen. However, if nothing is done for the relief of the hematoma these symptoms will appear within four or five days. This reaction is the result of the infection of the hematoma through a rupture of the septal mucous membranes occurring at the time of the fall and resulting in a septal abscess.

The general practitioner would be wise to send these cases to the hospital when first seen, and if there is a competent rhinologist available to have him in for consultation. If this is not possible, the next best thing to do is to administer an anesthetic, make an incision at the mucocutaneous margin on both sides of the septum and evacuate the hematoma, being careful not to do further injuries to the tissues. Then, by the use of a Gruenwald forceps or other type of biting instrument, cut out a strip of mucous membrane about ¼ inch in width and ⅜ inch long on each side of the septum in order to establish free drainage of the hematoma. From this point the manner of treatment is in the hands of the surgeon taking care of the case. One thing that should be borne in mind however, is the fact that packing of any sort should not be used. There is no set formula for taking care of these cases after this operation, but our best success has been obtained by using hot saline irrigations in the anterior part of the nose, every three or four hours until the swelling subsides and the tissues are well on their way to resolution. Irrigations may be stopped as soon as the child can breathe through his nose.

Children falling on their nose very often fracture the septal cartilage without the formation of the hematoma, but causing an

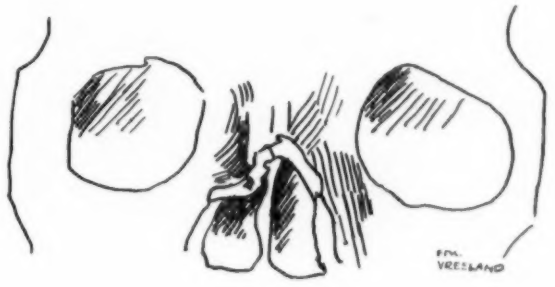
Fig. 2. Septal abscess.

Fig. 3. Right angle fracture.

almost right angle deviation of the septum in its anterior third. This sometimes results in a marked twisting of the tip of the nose to one side with a complete obstruction of one nostril and a compensatory obstruction of the other nostril. There may also occur a fracture of the cartilage along its horizontal diameter in such a way as to form a severe ridge or spur in the septal cartilage itself with a lateral deviation of the tip to one side.

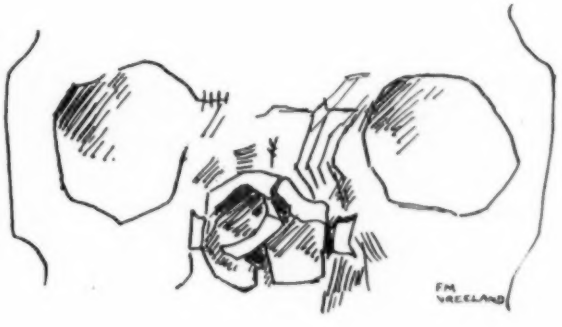
Much can be done for these cases if they are seen by the rhinologist within a reasonable length of time after the injury, but if two or three days elapse before the child is seen in consultation, it may be too late to do anything, or to form an opinion as to the amount of damage done. We often consider it the better part of discretion to wait until some of the swelling subsides, before making an examination or instituting any form of treatment requiring manipulation of the tissues. At this stage, these cases are problems enough for the competent rhinologist and no general surgeon should feel that he knows enough about treating such conditions to interfere.

Fractures of the nasal bones and the associated bone of the face in children are usually of the green-stick variety, unless the injury be a severe one of the compound comminuted type. The fact that the majority are of the green-stick variety make them more difficult to handle. It is practically impossible to show some of these fractures with the *x*-ray picture and the swelling of the soft tissues is often such, as to make it difficult to determine accurately, the extent of the injury when the case is first seen. After the soft tissue swelling subsides, there may be a noticeable swelling on the surface of the nasal bone, or the nasal process, as a result of the reaction of the periosteum to trauma. The bone or bones on the injured side of the nose become thicker and more resistant and have a tendency to influence the development of the bones on the uninjured side. This may cause a lateral deviation of the bridge of the nose which secondarily effects the position and growth of the septal cartilage. In children, it is impossible to tell how much influence the fall or other injury will



AFTER KAZANJIAN
GROUP I

AFTER KAZANJIAN
GROUP II



AFTER KAZANJIAN
GROUP III

FIG. 4.

have on the future growth of the nose. Hence, they should be kept under observa-

tion and treatment instituted if and when it is deemed advisable.

Care and judgment must be used in the surgical interference of these cases, and one cannot state at what particular age interference is justified. If the condition is such that it interferes with the health and happiness of the child, surgical interference is justified at any age. However, the operator must bear in mind the fact that he is dealing with young growing tissue and be careful not to destroy any more than is necessary and to have a wholesome respect for the centers of growth and ossification (Figs. 2 and 3).

In fractures of the nose in adults we do not have to take into consideration the many problems that confront us with children. It is mostly a question of determining the type of fracture with which we have to deal and instituting the proper mechanical measures for a realinement of the bones involved and holding them in position long enough so that they may become fixed in the normal process of repair.

The types of fractures in adults vary with the direction in which the force strikes the arch of the nose and I believe that Kazanjian of Boston has illustrated this very well in an article[1] before the Academy of Ophthalmology and Otolaryngology in 1933, in which he divided the fractures into three groups (Fig. 4).

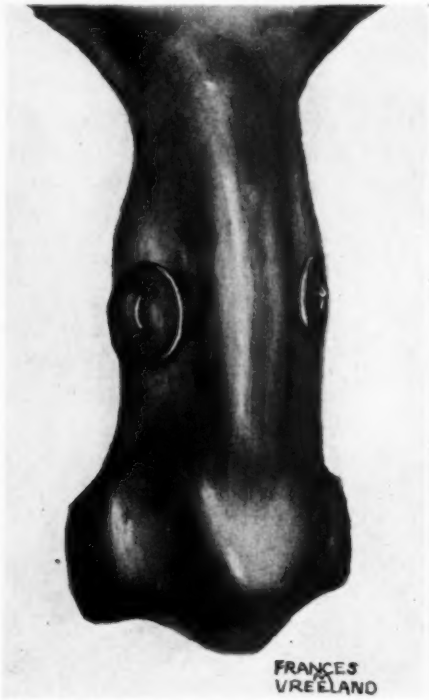


Fig. 5. The Gordon B. New method.

Fig. 6. The Joseph D. Kelly method.

Force delivered from above downward on the side of the nose usually causes a depressed fracture of the nasal bone and the upper and anterior portion of the nasal process and possibly the lacrimal bone on that side. Force delivered laterally may cause a fracture and displacement of the nasal bones and the upper part of the nasal processes. Force delivered from above along the whole upper surface of the nasal bones may cause a separation and fracture of these bones together with the nasal processes, thereby giving the nasal arch a more flattened appearance. Sometime the nasal bones may be comminuted with the maxillary borders overlapping the nasal processes of the maxilla. The bony septum is often involved together with the cartilaginous septum which may be twisted or

[1] Kazanjian, V. H. *Tr. Am. Acad. Opbth. and Oto-Laryngol.*, 1933, pp. 275–308.

bent or completely separated from the nasal bone.

Fractures of the nose are not difficult to diagnose as there is usually a history of injury and the symptoms are very obvious. The soft parts show considerable swelling immediately following the injury and the contour of the nose is disturbed, depending upon the degree of the severity of the trauma and the displacement of the fractured parts. Very often we can get crepitus and there will be tenderness on pressure over the site of the fracture. There may be a hemorrhage from one or both sides of the nose with difficulty in breathing caused by the swelling of the mucous membranes. When the case is not seen until some time after the injury, a roentgenogram will often show the fracture.

Treatment of the case varies according to the degree of the injury. If there are any lacerations of the skin, these should be thoroughly cleansed, and all foreign bodies removed, and the edges carefully approximated with fine suture material and with small needles, such as those used by the eye surgeon. Time may be allowed for the inflammation to subside before the reduction of the fracture is undertaken, but most men agree that it should not be delayed more than ten days at the outside.

For anesthesia in the reduction of a simple fracture it may only be necessary to pack the nose with gauze and cotton saturated with a mixture of equal parts of 10 per cent cocaine and 1:1000 adrenalin. The pledgets of gauze or cotton should be placed in the nasal fossa in the location of the fractured area and allowed to remain in position for fifteen or twenty minutes. However, if the patient is very nervous and excitable, nitrous oxide and oxygen anesthetic may be used. Then with the aid of a Ballenger elevator which is placed along the upper part of the septum in the area of the fracture, the nasal bones are lifted from their depressed position to a proper alinement with the nasal process. If the fracture is of the second degree and the displacement involves the bones on both sides of the nose, it may be necessary to alternate the elevator from one side to the other, using the thumb as a fulcrum and forcing the nasal bones to the median line, at the same time elevating them into position. If there is a fracture or dislocation of the septal cartilage at the chondro-osseous junction, in addition to the bony fracture,

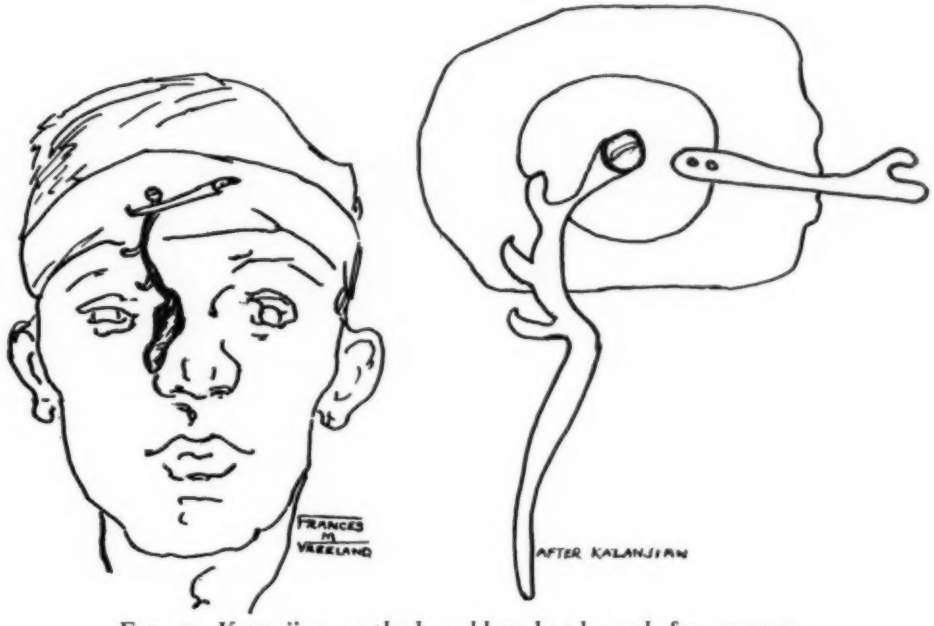


Fig. 7. Kazanjian method; rubber band used for pressure.

it may be necessary to pack either one side or the other of the nose with vaseline gauze in order to keep the cartilage in position. In depressed fractures involving the whole arch of the nose, with considerable comminution of the nasal bone as shown in type III, it may be necessary to devise or use some one of the mechanical devices constructed for the purpose of keeping the fragments in position long enough for them to be united. The use of any splint or any device which does not elevate the fragments should not be considered. New[2] of the Mayo Clinic uses a suture of nonabsorbable material, such as horse hair or deknatel, which is placed through the lower area of the fragments, and he so attaches a lead plate or button to each side of the nose that it lifts the fragments into position. We have made use of this method, substituting the ordinary copper wire with lead shot for the suture. It may be necessary to use some arrangement attached about the head, but this is very seldom required except when the injury involves other bones than those forming the nasal arch. Kazanjian has devised a very ingenious method of handling fractures causing a lateral displacement of the nasal arch, or of the bones on one side of the nose (Figs. 5, 6 and 7).

[2] New, G. B. *Surg. Cl. N. Am.*, 15: 1241–1250 (Oct.) 1935.

SUMMARY

Simple fractures of the nasal bones if corrected early should not show any evidence of deformity. Occasionally, however, it may be necessary to refracture the nasal bones in order to reduce the displacement and hold them in position by an external splint. Moderately severe fractures, complicated by displacement of the septum, may require an operation for submucous resection if they are seen two weeks or more following injury. In comminuted fractures of the nasal arch it is very necessary that the cases be handled carefully, because if the injury is a severe one and proper reduction of the fracture is not effected, and the fragments are not held in position long enough, they will undoubtedly come to a secondary operation requiring a transplant of cartilage, or cartilage and bone, for the relief of the deformity.

In closing I would like to say that in order to understand the fractures and displacement that may occur in the nasal bones it is necessary to keep in mind the anatomy of the external nose, the position of the nasal bones, and their relationship to the nasal processes of the superior maxillary bones and also the position and shape of the upper and lower lateral cartilages and the septal cartilage.

FRACTURES OF MANDIBLE AND MAXILLA

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FRACTURES of the upper and lower jaws present a different problem than fractures of any other bones in the body for we are dealing here not only with the broken continuity of a bone and its attendant problems, but with the restoration of the masticatory apparatus which requires the interdigitation of thirty-two or less teeth with the exactitude of a precision instrument. The reestablishment of the normal relationship between the teeth in the upper jaw and those of the lower jaw is the ultimate and final goal of treatment, and upon this more than any other factor should the results of the case be judged. To enumerate and classify the causes of these fractures would be to waste time on a subject of little more than academic interest. With a bone exposed as the mandible is, jutting out from the skull like a peninsula, differing from the bones of the extremities in that it can move in but one small arc to protect itself from impending trauma, and also that from the beginning of man it has received more than its just share of attention at the hands of the belligerently inclined; a bone whose structure is inherently weakened by the implantation of teeth in the same manner that knots reduce the strength of a hickory plank, it is a wonder, not that it is frequently broken but that it is not commonly broken. Let it suffice to say that the fist, the steering wheel and the automobile dash board are largely responsible for this injury. Furthermore, practically all fractures of the maxilla and mandible are compounded. The maxilla is almost always compounded into the oral cavity, the maxillary sinus or the nasal cavity. In the mandible, those fractures of the condyle, the coronoid process and the upper part of the ascending ramus, which are deeply imbedded in soft tissue, are practically the only ones which are not compounded; fractures of the body invariably rupture the tightly drawn and inelastic mucous membrane covering or produce a break along the root of some tooth. Fortunately, for the human race, these two bones have built up a certain degree of localized immunity to infection which is of inestimable aid, but which I fear has lulled many men into a position of false security and induced them to take liberties that they would not take with bones in other regions of the body. Unless handled with sound, surgical principles, infection is all too likely to occur.

The most practical and certain method of accomplishing the desired result is the early reduction and immobilization of the fracture in such a way that the teeth are directly placed in their proper occlusion. This necessitates the use of some adequate method of wiring, which will hold the jaws firmly together. As this naturally restricts the airways and makes the emission of vomitus difficult, it sometimes has to be delayed until the general condition of the patient warrants it, as in such cases as shock and injuries to the head, chest and abdomen. It should be instituted as soon as possible, however, as delay makes reduction difficult, invites infection, and is largely responsible for those cases of delayed union and non-union which are the bane of all fracture work. Because of post-anesthetic vomiting, general anesthetics are rarely used. The few times when there is resort to them are in nervously unstable people and small children, and then the wiring should not be carried to the point where the jaws are fastened together until

all chance of vomiting has passed. In general, these cases need rarely be hospitalized and lend themselves excellently to office practice and local anesthesia.

As the restoration of occlusion normal to the individual is the aim of treatment, so an abnormality of occlusion is the outstanding sign in the diagnosis of fractures of either jaw. Other signs and symptoms are drooling, inability to bite hard, a false point of motion, displacement of parts with deformity, localized tenderness, indirect tenderness, crepitus, ecchymosis and in the upper jaw, occasionally emphysema. The roentgenogram is, of course, of great help in the lower jaw but frequently of little value in the upper, as the maxilla is so often driven upward and backward and impacted upon the adjacent bones that a line of separation is not presented. A careful clinical examination will usually establish a diagnosis. All parts of the mandible should be radiographed before treatment is instituted as these frequently reveal fractures of the condyle or some other region which would have been masked clinically by the more evident fracture. They should be carefully studied for comminuted fragments and teeth in line of fracture. With few exceptions, teeth in the line of the fracture should be removed and certainly all fractured teeth in the line of fracture, as they tend to promote infection and delay union. Comminuted fragments should be retained wherever possible. Because of the greater vascularity and thin cortical structure of the upper jaw most fragments which still retain their periosteal attachment will live and form a part of the healing process. Fragments in the lower jaw, with its relatively avascular structure, however, are much more likely to die and the same liberties cannot be taken in leaving them in situ that can be taken in the upper jaw.

The method of immobilization which I use almost exclusively and which is in no sense original with me, can be best understood by a study of the illustrations. After reduction has been accomplished to the best of one's ability an 18 gauge German silver wire is cut so as to extend from the posterior border of the last tooth in the upper jaw on the right side, to the posterior border of the last tooth on the left side and is then so bent as to touch, when completely free of tension, the outside surface of every tooth in the upper jaw. This German silver band wire is then firmly fastened to the upper jaw by passing 22 gauge brass wires around each individual tooth and the band wire. The same thing is done in the lower jaw. At this point all we have is two band or arch wires firmly fastened to each jaw, but with the jaws open and free of each other (Fig. 1). If a general anesthetic is being used the procedure should stop at this point until all chances of postanesthetic vomiting has passed. A 26 gauge brass wire is then doubled and passed around the upper and lower band wires with the jaws in apposition and brought taut. Usually three of these intermaxillary wires are used on each side and usually in the molar and bicuspid regions, because these teeth are more powerful and better able to stand the strain than the incisor teeth (Fig. 2); but every case presents its own problem, and the available useful teeth are necessarily the ones to be utilized regardless of which ones they are.

This method has several distinct advantages over any other. In the first place, one can see the result being obtained which is not possible with the use of cast metal splints. In the second place, it distributes the strain of immobilization equally to all the available teeth and not to just one or two which is the case with other methods of wiring. In the third place, it is not necessary to obtain immediate and complete reduction as the intermaxillary wires may be placed in any direction and by using one jaw or the other as a fulcrum the fragments of the opposite jaw may be moved in any desired position, by the application of continuous, firm, but gentle tension exerted over a period of time (Fig. 3). This is particularly useful in those fractures in which the maxilla is so badly impacted upon the adjacent bones of the

skull that even with direct traction it cannot be dislodged, and in those fractures of either jaw in which there has been a delay in reduction, and healing has already started in malposition. In the fourth place, in cases of emergency or in periodic examinations, the jaws may be opened quickly and easily by merely cutting the intermaxillary wires and may be replaced in a few minutes without wrecking the whole system of wiring.

Every effort should be exerted to prevent infection of compound wounds no matter how slight they are. Adequate drainage should be established and maintained until the wound is thoroughly covered with granulation tissue. It is much easier to prevent than to cure an osteomyelitis, and besides, when infection does take place at the site of fracture, union is markedly delayed. It is a mistaken conception that the lower jaw is not easily infected, and it is not difficult to understand why this is, when one realizes that the patient is actually spitting into the wound every second of the day. No other bone in the body could withstand such a bacterial onslaught.

When the mucous membrane is sufficiently torn in upper jaw fractures to produce communication between the mouth and the antral cavity, the mucous membrane should be immediately sutured so as to close the mouth off from the antrum. If this is not done and the antrum is exposed to the invasion of mouth bacteria for any length of time, the whole procedure will very likely be complicated by an antral infection. It may be necessary to drain the wound to prevent infection of the bony fragments, but the drain should not be extended into the antral cavity.

Fractures of the condyle are rarely compounded because of the protective mass of soft tissue in which the condyle is situated. Reduction of these fractures is practically impossible unless one uses the open method, which procedure, however, is quite unnecessary. If the jaws are wired together with the teeth in their proper occlusion union will be obtained. Anatomically, as shown by the roentgenogram, the result is poor, but that is a matter of inconsequential importance because functionally the patient will get an excellent result.

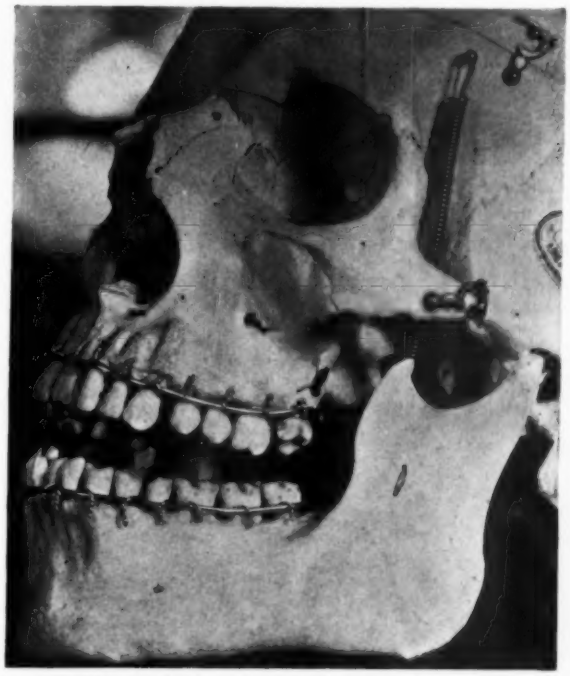

Fig. 1. Shows the band or arch wire adjusted to the tooth and fastened to each individual tooth.

There are some fractures at the angle of the jaw which present a special problem in maintaining reduction because of the constant pull of the muscles of mastication, chiefly the masseter and temporal muscles. The black mark in Figure 2 indicates the direction of such a fracture. In these cases, the line of fracture is such that it permits the posterior fragment to be drawn upward away from the anterior fragment. There are various methods of dealing with this problem. The simplest is to place some suitable material such as gutta percha or modelling compound against the upper teeth so that the posterior fragment will be held downward and in contact with the anterior fragment. This is not always possible, and when it is not, it is necessary to resort to some form of surgical wiring, such as boring holes in the posterior and anterior fragments and passing wires through them in such a manner as to hold

the posterior fragment down, or making an incision just behind the angle of the jaw through the skin and boring a hole through the posterior border of the ascending ramus through which a silver wire is passed and fastened to an elastic band and adhesive at the base of the head. The first method has the distinct disadvantage of implanting a foreign body in a contaminated area which will almost certainly become infected.

Fig. 2. Shows the intermaxillary wires running vertically with the teeth in occlusion.

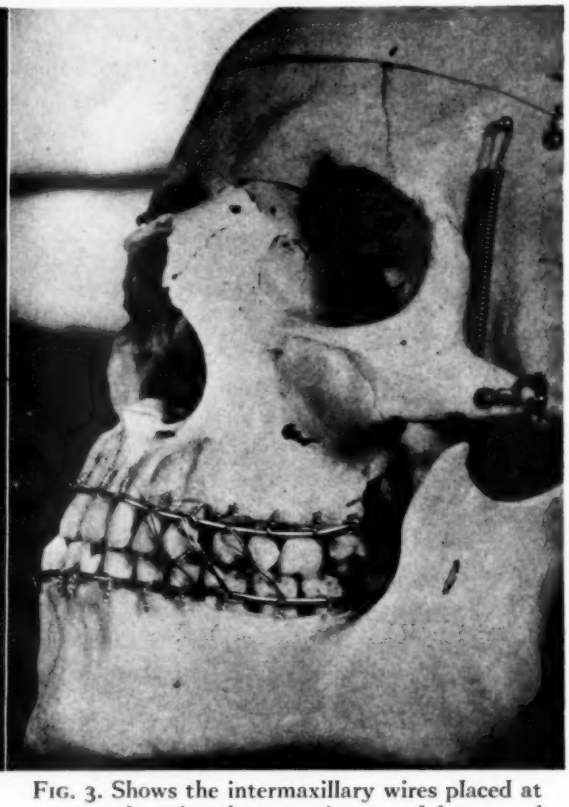

Fig. 3. Shows the intermaxillary wires placed at an angle, using the upper jaw as a fulcrum and drawing the left side of the lower jaw forward.

In edentulous cases, the fracture is reduced and maintained in position by means of a head bandage. I have found that all types of gauze bandages soon become loose and to overcome this tendency elastic traction with adhesive has been found most useful.

As I have previously noted, non-union or delayed union most commonly follows cases in which infection has set in or in which there has been a definite delay in immobilization. This is hardly the place to enumerate the other possible causes of this complication. There are several methods of dealing with it, but one simple method which in most cases is quite efficacious is to remove the intermaxillary wires and for two or three days permit the patient to gently open and close its mouth but not to masticate food. The jaws are then re-wired from one to two weeks when the procedure may be repeated as many times as is necessary. The gentle irritation produced in the line of fracture will frequently stimulate the deposition of calcium salts sufficiently to produce bony union. Another simple and quite satisfactory method is to bore small holes in the proximal surfaces of the fragments and keep the jaws immobilized. This will frequently stimulate bony union. If these relatively simple methods fail I believe that resort to a bone graft should be made but this is only possible after the wounds have completely healed. Cases of prolonged non-union requiring immobilization for several months introduce another serious factor in that the

supporting structures of the teeth suffer from atrophy of disuse. Some of the teeth may become extremely loose and eventually be lost. I have never seen diet or medication influence the course of these cases. However, I do believe that it is sound judgment to keep such patients out in the sun and put them on a high vitamin regime. Certainly no harm can result from it and it might do some good. The problem of feeding these fracture patients is relatively simple. They are placed on a liquid diet of high caloric content, and, in spite of the fact that they may have a full complement of teeth, they are always able to suck enough through their teeth to easily provide their normal nourishment.

In a paper as general as this it is impossible to speak in any detail of the various phases of this work, however, I should like to emphasize again that the end-result is to be judged by the restoration of the function of the masticatory apparatus.

SUMMARY

Fractures of the upper and lower jaws present certain problems peculiar to themselves in lieu of the fact that they are in close apposition to the accessory nasal sinuses and are a large part of the delicately balanced masticatory apparatus. The restoration of this apparatus is the chief aim of treatment. Fractures should be reduced and immobilized as quickly as possible and adequate drainage established to prevent infection. A type of immobilization which maintains the teeth of the opposing jaws in their proper relation and one which distributes the strain to as many teeth as possible is desirable. Local anesthesia is better adapted to this work than general.

FACIAL SCARS

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THE proper management of facial injuries is a surgical subject of great moment. With increasing numbers of facial lacerations following in the wake of ever increasing numbers of motor car accidents, skillful attendance by general practitioner and surgeon alike is required more frequently now than ever before. The immediate, so-called "emergency" care of these victims is but one phase of this subject. The management of the late sequels, namely unsightly scars, constitutes an equally important chapter. Their devastating effects upon the happiness, mental health and even livelihood of the disfigured victims must not be underestimated. The psychic trauma may cause more suffering than the physical lesion itself. Children are particularly affected; brooding over their defects has induced serious complexes and detrimental personality changes which blight their entire span of life. Sensitive adults, too, have become social recluses or business failures. The extent to which such psychological catastrophies have contributed to present social problems, particularly unemployment and unemployability, is difficult to determine, though undoubtedly great. The problem of facial scars thus presents many important aspects.

A first consideration in the management of the acute laceration should be the prevention of unsightly scar formation. Hasty, ill-considered "emergency treatment" is almost inexcusable. When proper facilities for painstaking repair are not available at the time, it is better to apply merely a sterile dressing and await a better opportunity. Immediate closure of facial wounds without preliminary cleansing and without careful trimming of the jagged edges cannot be too vigorously condemned. Equally blameworthy is the use of large skin clips or coarse catgut and silkworm sutures. Such closures practically always leave heavily pigmented scars with conspicuous stitch marks that are almost impossible to eliminate at a later date. The essentials, then, for proper closure of recent wounds of the face are careful cleansing of the laceration, removal of foreign bodies, trimming of skin edges, and the use of fine suture materials threaded on fine needles. Skin tension which leads to wound separation and the formation of wide scars should be eliminated by the use of buried tension sutures. These principles are of paramount importance in the prevention of unsightly scars following facial lacerations.

Surgical measures to improve the appearance of unsightly facial scars demand an equal regard for surgical principles lest trying to better we "mar what's well." A well equipped office operating room similar to that maintained in the modern hospital, is the first essential. Before attempting treatment, however, it is important that the patient should be told frankly what result may be expected. The lay press, unfortunately, has fostered the belief that all scars can be excised so as to "leave no trace." This notion, if held by the patient, must first of all be dispelled. Circumstances permitting, however, the patient can be assured of a cosmetic result infinitely superior to the old scar if well considered plastic procedures are properly carried out. It is important to recall that scars at right angles to the lines of Langer, due to stretching, will of necessity be more conspicuous than those which parallel these lines. The latter variety may eventually leave only a fine hair line, scarcely visible scar. Scars in young persons will remain red much longer than those of persons of middle and

advanced age. These and other important facts must be borne in mind since they determine the prognosis to an important degree.

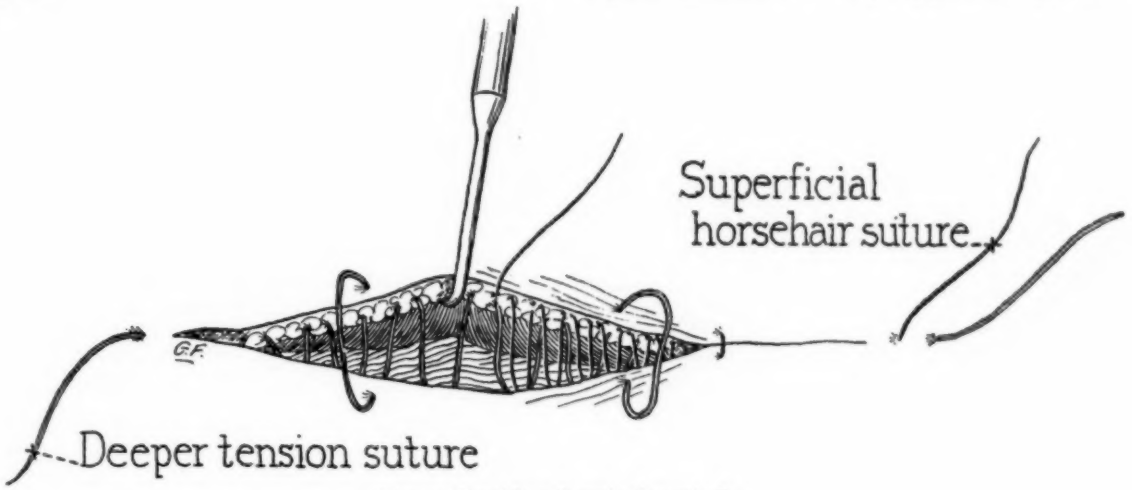

Fig. 1. Double subcuticular stitch.

The following resume outlines the usual procedures followed by the author:

Preparation.

1. Thorough cleansing of the entire face with green soap and water wash, followed by alcohol;

2. Infiltration around the scar with a 1 per cent solution of novocaine containing ten drops of adrenalin per ounce.

Operation. The scar is first completely excised, after which the surrounding skin is undercut to permit approximation of the skin edges. When scars directly overlie bone, a subcutaneous fat pad is provided by drawing in the adipose tissue from each side of the wound. This prevents adhesion to the bone and consequent scar depression. Skin tension is next relieved by the use of buried interrupted sutures placed in the subcutaneous fascia. The author prefers dermal and small white silk sutures for this purpose. Although some of these sutures are often extruded later, they nevertheless maintain wound approximation sufficiently long to prevent spreading and consequent wide scar formation. Buried sutures are used freely in scars crossing Langer's lines to counteract the pull of these elastic fibers.

Skin closure, the final step in the operation, is a most important one. The eventual production of a minimal scar depends to a great extent upon the skill with which this phase of the operation is executed. Interrupted sutures of any type are prone to leave stitch marks. For this reason the author advises the use of subcuticular sutures. A $\frac{5}{8}$ inch curved eye needle threaded with medium dermal suture is best. The needle is inserted into the skin $\frac{1}{4}$ inch below the lower angle of the incision and brought into the end of the wound. The stitch then passes subcuticularly throughout the entire length of the wound, picking up tissue every $\frac{1}{4}$ inch on each side at the base of the dermis and at exactly the same distance from the surface on each side. In a long wound, the suture is brought out to the surface on one side and inserted again on the opposite side making an external loop every 1 to $1\frac{1}{2}$ inches. This loop can later be cut to permit removal of the suture in sections. A second subcuticular stitch of horsehair, threaded on a fine semicurved eye needle, is next inserted at $\frac{1}{8}$ inch intervals just beneath the skin surface. This stitch should be brought to the surface at $\frac{3}{4}$ to 1 inch intervals to facilitate subsequent removal. These two subcuticular sutures bring about more perfect skin approximation and leave less residual scar than any other method known to the author (Fig. 1).

Slight wound separations may be approximated by a stitch of fine horsehair

threaded on a eye needle. Stitch marks are avoided by tying the knot with only the first two twists of the surgeon's knot. The second knot is omitted because it tends to increase wound tension and cause the stitch to cut the skin, thereby increasing scar formation.

Drainage is usually recommended in the primary closure of deep wounds. In secondary operations for the removal of scars, drainage is seldom necessary if complete hemostasis has been obtained.

Heavy dressings should not be used. One thickness of bandage material placed over the wound and held in place by means of collodion, placed *around*, not *on* the wound, usually suffices.

Bed rest is required for twenty-four hours. An ice bag is placed over the dressing and kept there more or less continuously for two or three days if necessary.

Removal of sutures is begun at the end of forty-eight hours. At this time, interrupted or subcuticular horse hair sutures are removed if they have loosened sufficiently. The subcuticular dermal stitch may be left in place for eight to ten days while firm union is taking place. This suture leaves no scar. Hence it may be retained for a longer period to minimize wound spreading.

In spite of all precautions, keloid formation will develop in persons with this diathesis. Postoperative *x*-ray therapy will usually improve or minimize this condition.

Trichloracetic acid applied on fine toothpick applicators is useful for smoothing down small overlapping skin edges. This may be repeated several times, if necessary, until the best possible cosmetic result is obtained. Cinder marks may also be removed in this manner by repeated applications at two or three week intervals.

SUMMARY

1. Prevention of conspicuous scar formation should be the chief aim in the management of acute facial lacerations. Adherence to certain principles will prevent or minimize such scars; thorough wound cleansing; avoidance of wound tension by the use of buried tension sutures; the use of fine suture materials and needles. Heavy suture materials, such as skin clips, catgut, silkworm gut, etc., have no place in facial surgery.

2. Secondary operations to remove unsightly facial scars also require finer methods of suturing and wound treatment.

3. The psychological benefit which may be derived from the removal of very conspicuous scar formation must not be overlooked. Persons handicapped by such deformities may be restored to society and business by well considered, carefully planned surgical procedures.

CONCEALMENT OF SCARS

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OF the various factors that render scars visible, the color, erythematous in the early stages, is one of the most important. Though the technique of suturing might have been painstaking, the healing by primary intention, neverthe-

FIG. 1. The result of multiple Davis grafts to the head for traumatic avulsion of the scalp.

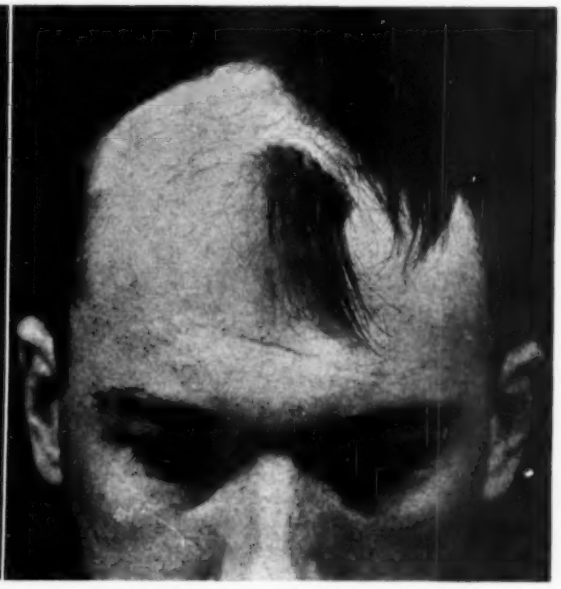

FIG. 2. Scars covered with covermark.

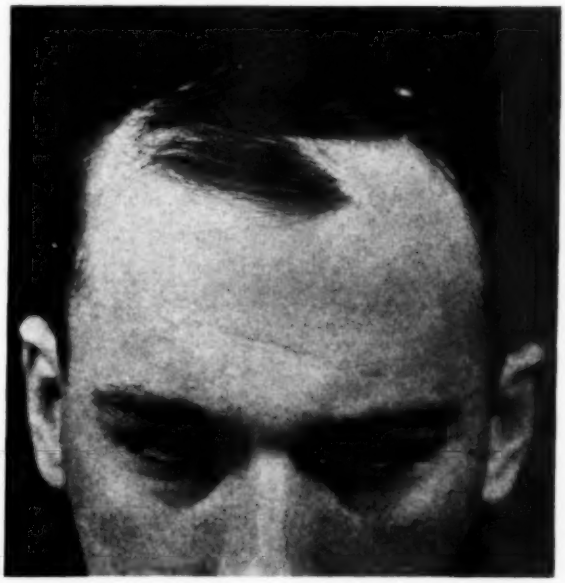

FIG. 3. The resultant scar rendered practically inconspicuous with covermark.

less, the reddish color of the scar and its shiny surface texture will vitiate some of the satisfaction of the patient with the result. Particularly is this true, obviously, with scars on the exposed surfaces, and especially the face. In time, of course, most scars will fade, but until they do, patients will be grateful for an inexpensive, harmless means of concealing the scars. This means is provided in covermark, which is a colored cream base, available in a number of shades to match the complexion. The cream is applied to the scar and smoothed on the skin. The accompanying photographs show the results obtained by the application.

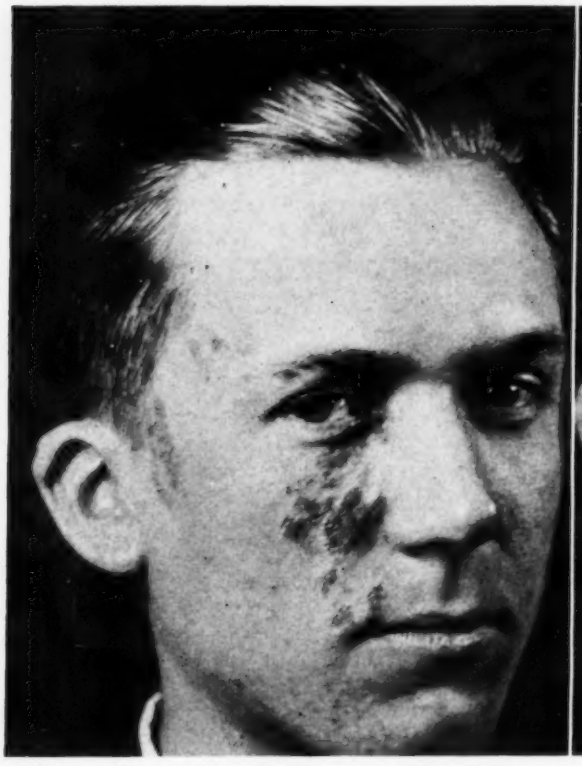

Fig. 4. A case of multiple more or less discreet hemangiomata (port wine stain). These areas were excised.

Fig. 5. The scars covered with covermark.

STYES

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THE hordeolum, or stye as it is more commonly known, causes subjective and objective symptoms out of all proportion to its seriousness. The result of a suppurating inflammation of a solitary Zeis or Meibomian gland of the lid, it begins with an inflammatory edema of the affected lid, which at times spreads markedly to involve the bulbar conjuctiva, or more alarming to the sufferer down onto the face. Shortly there develops a point of localized tenderness and induration, which marks the location of the involved gland, followed in two or three days by evidence of suppuration, a yellow spot appearing at this site, which later breaks down and discharges pus. Should the Zeis gland be involved, as most usually happens, this point of suppuration occurs at the margin of the lid on the skin surface and in an infection of the Meibomian gland on the tarsal surface or at the mouth of the gland on the intermarginal space.

An occasional solitary stye being analogous to the occasional acne pustule from which most individuals at one time or another suffer, represents, bacteriologically and pathologically, an infection by the staphylococcus of a sebaceous gland. A single stye, then, is of no serious consequence apart from the passing discomfort and need of local treatment.

However, two groups of individuals tend to suffer from recurrent crops of styes and for these the physical and, in women, the mental anguish is often considerable. The first group includes those sufferers from blepharitis whose red, crusted and scaly lids furnish an excellent media for growth of the staphylococci. The second group consists of children and adults with normal lids, who because of poverty and poor living conditions, fail to obtain sufficient fresh air, sunlight and adequate food; or those adults who because of overwork, lack of sleep and fresh air become "run down" and anemic and whose lowered resistance renders them susceptible to an infection to which they would otherwise not succumb.

The treatment of the stye itself consists in the application of hot moist compresses fifteen to twenty minutes three or more times daily until the point of suppuration appears, at which time an incision is made with a sharp pointed knife, and the pus evacuated. It is usually advisable to continue the compresses for a few days after this, because in this way, the return of the lid to its normal appearance is hastened. It would seem that eventually the practitioner would learn that the application of yellow oxide of mercury is not of any value in the treatment of a stye and usually aggravates the condition, but it is still the universal home remedy and many a physician is guilty of encouraging this form of medication.

In the cases of recurrent styes, in addition to the local treatment, the blepharitis if the underlying cause must be treated, and if the patient's poor health be the causative factor, it is most important that means be undertaken to remedy the situation with more rest, fresh air, etc., and treatment of anemias or other pathological conditions. Occasionally all other attempts at prevention failing, autogenous vaccines may possibly be of help. While many oculists stress the importance of wearing glasses which correct refractive and muscle errors as a means of preventing styes, it is my experience that this form of therapy is not of much value or importance.

CINDERS AND SPLINTERS

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MANY transient patients demanding emergency minor surgery have become permanent through the ability of the doctor to give quick relief without additional pain. Every office should be equipped with instruments specially designed for the removal of foreign substances such as cinders and splinters. Nothing is more disconcerting and can ruin a day so completely as to spend an hour trying to remove a cinder or find a splinter, with ill suited tools and poor anesthesia, and finally give up saying, "Better go to the hospital and take a general anesthetic in the morning."

The preparation of the patient has a good deal to do with the success of the original procedure. For instance, a cinder in the eye will be much more amenable to removal if a drop of 4 per cent cocain or one of the local anesthetics, butyn or metacain, is placed on the cornea before any detailed inspection is undertaken. A hand with a splinter will be a much easier problem if soaked in hot soapy water for ten or fifteen minutes, while the instruments are boiling. A comfortable table with the patient lying under a good light during the surgery is a necessity.

Eyes are so important that one should know whether or not they are competent to remove a deeply embedded foreign body and handle the possible complications. If complications do develop and it is necessary to call in an eye specialist, no one is going to thank you for your desire to take a try at it. However, there is no harm in inspecting the eye, after preliminary anesthesia, to see if a foreign object is present and if undiscernable, to instill a drop of 1 per cent aqueous mercurochrome to show up possible scratches on the cornea. An alert secretary once in taking a careful history of an eye case, where I could find nothing, disclosed the possibility of exposure to steel splintering and an indicated *x*-ray examination saved the day for me by disclosing a good sized piece of steel in the eye ball.

The increase of automobile accidents, even with the growing tendency of all-steel bodies, still presents us with a variety of foreign substances. The most common is that of a graphite-like substance from oil drippings and exhaust pipes, which is fast forming a complete covering on all of our streets. This graphite-like material is the dark blue substance which appears under the scar surface about the time the patient is debating whether to make the final payment on your bill. It is usually deposited deep in the wound in small particles and in the rush to close the wound to stop bleeding, it is encapsulated and appears at the surface later.

Receiving hospitals ordinarily do not have time to adequately take care of cases presenting lacerations with possible inclusion of foreign material. The reason is that the average case will do a great deal better if no attempt is made at a complete and immediate repair, all arguments regarding the wound being sterile for the first six hours notwithstanding. Attention to acute hemorrhage, followed by a moderate cleansing of the wound with liquid soap and water, or peroxide followed with alcohol or mild iodine, will insure moderate asepsis. A moist dressing, with sufficient pressure to control too brisk oozing, kept on until a convenient time for a more leisurely and efficient repair, will give a cleaner and dryer wound in which to work.

This plan allows the patient relief, both mental and physical, and an opportunity to arrange his time and affairs to suit the best interests of all concerned. If roentgenograms are indicated for localization they may be taken during this interval. Incidentally it takes an excellent radiologist to find a non-metallic foreign object, be it cinder or splinter, and he should be given plenty of time for his search. Films, utilizing two to four positions, will materially simplify a long dissection. If antitetanic serum is indicated, it may be given underneath the abdominal skin after first freezing the area with ethyl chloride sprayed through an opening made in a double thickness of adhesive. This gives anesthesia at the point desired and protects the surrounding skin.

Not every splinter need be removed. Men who are wood workers and who have hard calloused hands will show numerous splinters which have been embedded for weeks with no irritation. These work to the surface by themselves.

It is amazing the large size of splinters which may be embedded in soft tissue without a great deal of distortion or swelling. The subcutaneous hardness is ascribed to induration, while subsequent efforts at removal may bring out various amounts of debris for days. The best way of looking for a splinter is to work from the point of insertion rather than trying to short cut to the area where you think it should be. A strong concentrated light for transillumination is oftimes of value. Splinters under the nails are tremendously painful, and anesthesia will best be attained by a circular injection near the joint, rather than to add insult to injury by attempting to inject under the nail.

I learned from a dentist some years ago to use a "carpule" syringe for local anesthesia. Aside from its general efficacy in surgery, I find that by keeping the novocain carpules and needles submerged in an antiseptic solution, I have an emergency set-up, par excellence. The use of a 27 gauge needle with a long flat bevel materially aids induction. Some surgeons refuse to use any syringe medication that is not carpule contained, thus insuring against possible accident in solution preparation.

A surgical nurse taught me that a No. 11 Bard Parker blade is a good instrument for foreign object removal. I have found that either a Ralk's or a Watter's splinter forceps and an eye spud with the three interchangeable spuds of stainless steel are necessary for the instrument set-up. A "Berger loupe" or a good headlight and a magnifying glass are indispensable aids. Harold Gifford, in my school days, demonstrated the necessity of immobilizing an eye after a foreign object removal. There is a simplified eye shield on the market, made for either eye, that does away with adhesive strips and simplifies removal by the patient for home irrigations and instillation of a mild ophthalmic ointment as indicated.

CONCLUSIONS

It is extremely important that all foreign matter be removed from skin wounds, especially on the face. As a plastic surgeon I find a large percentage of cases coming to me for the repair of seemingly trivial scars which could have been avoided by a little extra care at the time of the injury. These defects oftimes reach such importance in the patient's mind as to become a major obsession. These people are from both sexes and of all walks and occupations of life. They all have the same story, "The doctor said it would not amount to anything and to forget about it." They are willing to go to a great deal of trouble and expense in their desire to look like their old selves. The prevention of such problems lies in the preparedness of the doctor. We must remember that as in business, the small order often brings the big order.

"For the Colonel's lady and Judy O'Grady
Both get cinders and splinters under their skin."

FOREIGN BODIES IN EXTERNAL AUDITORY CANAL*

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A SURVEY of the records of The Mount Sinai Hospital reveals that foreign bodies in the external auditory canal occur most commonly in young female children between two and one-half and seven years of age, the right ear being involved more frequently than the left. The experiences of Keen,[1] however, are not in accord with ours; of 51 cases of foreign body in his series, omitting the cotton wool variety, there were 23 in the right ear, 27 in the left and one not stated. Keen advanced the explanation that five or six year old children when playing, are really ambidextrous.

Previous unsuccessful attempts at removal were the rule in our patients. This is in agreement with the experiences of Politzer[2] who stated that hardly 10 per cent of the cases which come to the specialist had not undergone some manipulation. Some of the foreign bodies removed by us included beans, peas, a piece of porcelain crockery, glass beads of varied sizes and shapes, a tooth, a button, small pieces of graphite from a lead pencil, pieces of onion and cotton. The commonest foreign body encountered in adults, according to Asherson,[3] is cotton wool which generally is inserted by the patient and forgotten. Other authors have reported finding fruit seeds, pebbles, glass, shot, insects, larva, coffee beans, slate, etc. Foreign bodies in the external auditory canal may be divided into two groups, those which cause few, if any symptoms and those which cause severe symptoms.

1. *Foreign Bodies Which Cause Minimal Symptoms.* Occasionally during the course of an otolaryngologic examination, a foreign body may be discovered in the ear. For example, a child was referred to the Out Patient Department for an opinion as to the advisibility of tonsillectomy. On looking into the external auditory canal, one saw a round red object which moved when the head was rotated into various positions. It was ascertained upon questioning the parent, that the child frequently played with a red bead necklace. On syringing the external auditory canal with warm water a small bead was washed out.

Another patient was seen in the clinic complaining of foul smelling discharge from the right ear of many years duration. The canal wall close to the tympanum was covered with granulations. There was considerable purulent discharge in the external auditory canal and the tympanic membrane was not visible. Upon touching the granulations with a probe, the dirty grayish area which was thought to be the inner tympanic wall covered by granulations, moved. With a bayonet forceps, the grayish mass was gently loosened and removed. To our surprise, it was a piece of cotton about ¼ inch thick, encrusted with calcium salts. The drum was found intact. Within a few days, the granulomata on the canal wall disappeared and "the middle ear discharge" of many years duration ceased.

Politzer[2] reported an instance in which a piece of slate 3 cm. long was present in the external auditory canal for fifty years with no complaints other than deafness. The patient was seventy years old at the time of the removal of the slate and complained only of poor hearing. Zaufal[4] and Lucae[5] reported removing cherry stones from the external auditory canal of asymptomatic patients after forty and forty-two years respectively. Wells[6] reported a case of deafness of thirty-three years duration resulting from placing a pea into the

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external auditory canal which was cured after removal of the foreign body.

2. *Foreign Bodies Which Cause Symptoms.* As was stated before, some foreign bodies cause few symptoms whereas others may cause severe symptoms such as extreme nervousness, headache, reflex trigeminal and vagal manifestations. In 1909 Dimitriadis[7] published a monograph containing a complete and excellent historical bibliography of the literature on foreign bodies. Abdulla[8] reported a case of intractible hiccough which resisted even large doses of morphine, but which was relieved after removing an impacted plug of cotton wool from the external auditory canal. It was formerly a common practice for inhabitants of India to place cotton wool scented with "Itter" into the auditory canal. In 1646 Fabricus v. Hildanus[9] reported curing a patient suffering from epileptiform attacks and cough of eight years duration, by removing a glass bead from the external canal.

Within the past ten years there have been numerous and unusual reports of foreign bodies in the external auditory canal. Foster[10] reported a bizarre case in which a facial paralysis cleared up after removing a tick $\frac{3}{16}$ inch long which had embedded itself in the floor of the external auditory canal. Irrigations removed considerable debris and pus, and the author then could see what proved to be a blood engorged tick which he removed with a forceps. Chavanne[11] described a patient with headache and vertigo, in whom the symptoms ceased promptly after the removal of foreign body from the external auditory canal where it had been pressing against the drum. Kennedy[12] described a case of persistent cough of thirty-six years duration which was alleviated following the removal of a rice grain from the ear canal. Hilton[13] reported an instance in which a boy thrust an eraser from the end of a lead pencil into his external auditory canal. The eraser could not be removed in toto. Ultimately the retained eraser caused an erosion of the drum and annulus, necessitating radical mastoidectomy before a cure was effected. Many instances have been reported of flies in the external auditory canal causing severe symptoms. Richards[14] cautions against trying to remove flies with a forceps even under direct vision advising that they will be difficult to grasp and that there is danger of doing damage with the forceps. The insect should be killed first by instilling a few drops of a mixture of chloroform and oil into the external auditory canal and then removed by irrigation. One of the most unusual foreign bodies on record was reported by Seshachalam[15] who removed a living scorpion 1 inch long from the external auditory canal. This patient was awakened at 4 A.M. with severe pain in the ear and five hours later in a hospital the scorpion was removed by syringing. Chalier and Rousset[16] reported a tragic case in which a three year old child pushed a small stone into his external auditory canal. Attempts at removal failed. Some time later the child was brought to a hospital with obvious tetanus which, despite tetanus antitoxin, ultimately proved fatal. Large numbers of tetanus bacilli were found in the ear discharge.

Much of the trouble associated with foreign bodies in the external auditory canal arises from resort to forcible, ill advised attempts at removal usually by well intentioned parents or occasionally by general practitioners. The difficulty in removing foreign bodies, according to Asherson,[3] increases rapidly in direct proportion to the number of previous unsuccessful attempts at removal.

Certain foreign bodies when moistened, swell to many times their original size. This characteristic must be borne in mind, because forcible irrigations of these foreign bodies will result in swelling and further impaction. Repeated instillations of absolute alcohol will often cause drying and shrinkage of this type of foreign body, making subsequent removal easier. Small hygroscopic objects when dry, may readily enter the external auditory canal. After an interval of time they may swell and com-

pletely fill the external canal, frequently with resultant severe symptoms.

Brief mention will be made of a few of the cases of aural foreign body observed during the past three years at the Mount Sinai Hospital and Out-patient Department in order to point out certain important features in the treatment. One case will be discussed in detail, because it demonstrates some of the complications that may develop.

CASE REPORTS

Case I. I. C., female, aged three years had a foreign body (bean) in her *right* external auditory canal. Previous attempts at removal without anesthesia were unsuccessful. Admitted to the hospital and under general anesthesia, bean was removed with a blunt hook. The drum was found to be intact. Ammoniated mercury ointment 5 per cent was applied locally.

COMMENT. It is best not to irrigate beans and like vegetable matter. They are likely to swell and become impacted. It is safer to remove them with instruments or probes under direct vision.

Case II. M. P., female, aged seven years, had a foreign body (piece of porcelain crockery) in the right external auditory canal which was found to be deeply imbedded. There was considerable edema and narrowing which resulted from previous unsuccessful attempts at removal without anesthesia, prior to admission to the hospital. Under nitrous-oxide oxygen anesthesia, the foreign body was grasped with forceps and gently removed. Ammoniated mercury ointment 5 per cent was applied to the canal.

COMMENT. Sharp, heavy, irregularly shaped foreign bodies of this type at times may not be removed by syringing. It is best to attempt removal with forceps, watching the edges of the foreign body so that the canal is not traumatized.

Case III. M. N., female, aged three years, had a foreign body (glass bead) in the right external auditory canal. Previous attempts at removal were unsuccessful. Under general anesthesia the bead was easily washed out by syringing the external auditory canal. Drum was found to be intact. Ammoniated mercury ointment 5 per cent was applied locally to the canal.

COMMENT. Small beads with smooth surfaces may be difficult to grasp with instruments. Frequently, however, they are easy to remove by forcible syringing.

Case IV. S. L., male, aged seven years, had a foreign body (tooth) in the right external auditory canal. Efforts at removal by parents were unsuccessful. Under general anesthesia the impacted tooth was grasped with a forceps and removed. The drum was found to be intact. Ammoniated mercury ointment 5 per cent was applied locally to the canal.

COMMENT. Under direct vision this type of foreign body is easy to grasp with forceps and remove.

Case V. T. R., male laborer, aged forty-five years, suddenly experienced pain in his right ear while working on a road construction job. On examination, a small piece of gravel was seen embedded in the outer layer of the drum. All landmarks were visible. Under local anesthesia, the foreign body was gently removed with a blunt curette. Follow-up a few days later showed complete resolution about the site of the foreign body.

COMMENT. If irrigations fail, we found that using a blunt curette under direct vision, was most successful in dislodging and removing the foreign body.

Case VI. E. G., female, aged five years, had a foreign body (bead) in the right external auditory canal of eighteen hours duration. Many unsuccessful attempts at removal made without anesthesia before admission to the hospital. The foreign body was impacted and there was considerable narrowing at the isthmus. Under general anesthesia syringing proved unsuccessful. A small hook was inserted into the hole in the bead and the foreign body thus extracted. Ammoniated mercury ointment 5 per cent was applied locally. The drum was reddened but within a few days the drum was completely resolved and the patient was discharged well.

COMMENT. This type of case is potentially dangerous. As is well known, the cartilaginous canal is somewhat elastic whereas the osseous portion of the canal is rigid. Frequently it is easy to remove a foreign body when it is in the distensible portion of the canal, whereas it may be very difficult or impossible to remove it if it becomes impacted in the bony portion of the canal. Fortunately in this instance the small hook engaged the hole in the impacted bead thus making removal possible. Whenever

hooks are used in intrameatal manipulations one should always use direct vision and have excellent illumination.

Case VII. C. B., female, aged three years, had a foreign body (bead) in the right external auditory canal of ten hours duration. Previous attempts at removal were unsuccessful. The foreign body appeared impacted at a point just beyond the junction of the cartilaginous and bony canal walls. The auricle and external auditory canal were inflamed. Bloody discharge oozed from the canal wall about the bead. In the Emergency Ward, without anesthesia, attempts were made to remove the foreign body by irrigation without success. Under nitrous-oxide oxygen anesthesia, attempts were made using a soft silver probe, small hooks, etc., to dislodge or turn the bead and thus make it possible to slide a blunt hook between it and the drum and extract it. These maneuvers also failed. There was such marked swelling at the isthmus, that removal without great trauma appeared improbable.

Incident to the manipulations, the cartilaginous canal was traumatized, the resultant bleeding obscuring vision. Because of the danger of forcing the impacted bead into the tympanic cavity further efforts were discontinued. At this stage, to quote Asherson,[1] we were in that unenviable position of trying to remove a cork from a bottle without being able to use a corkscrew. A wet dressing was applied to the external auditory canal and auricle, to expedite subsidence of some of the swelling. It is of historic interest to mention at this point that Paulus Aegineta[17] in the sixteenth century made a postauricular crescentic incision for the removal of an aural foreign body which could not be removed by the available intrameatal methods.

Our patient developed fever, nystagmus to the left and pain, and therefore we dared not wait as long as we ordinarily would have for the edema in the canal to subside. The following day, a postauricular incision was made about ½ inch behind the auricle, the skin and periosteum reflected. The cartilaginous canal was separated from the bony canal. Already granulations were present on the bony canal wall about the bead, which was tightly wedged against the canal wall and drum. The foreign body was turned with a Barth curette and removed by irrigation. The drum appeared intact and quite edematous.

The bead was a large flat white one resembling a button, with an imitation ruby cemented into its center. This finding explained the impression we had that we were dealing with a red bead. Complete hemostases was obtained and the postauricular wound was then closed. The external auditory canal was tightly packed to avoid atresia of the canal, frequently a distressing sequel to this procedure. According to Richards particular care must be taken to replace the canal lining in order to avoid this complication.

Two days later the patient developed fever, angina, a strawberry tongue and a punctate rash over the body. The diagnosis of scarlet fever was made and the patient quarantined. Labyrinthine symptoms, nausea, vomiting, nystagmus to the left and falling towards the right side became manifest at this time. The tight packing was considered responsible for the irritative labyrinthine symptoms, and although we were loathe to remove the packing for fear of developing an atresia, it was deemed the more conservative of the two alternatives. The temperature was 103°F. and signs of an acute suppurative otitis media appeared on the right side. This ear discharged spontaneously. The external auditory canal became narrowed and inflamed. No landmarks were visible and granulations filled the fundus of the auditory canal. The postauricular wound did not heal and there was an enormous amount of thick pus from the middle ear. The rash disappeared. At this time no cause for the fever, leucocytosis and pain could be found other than the ear status. Two weeks after the removal of the bead, facial erysipelas developed. This was treated with ultra-violet rays.

Because of the profuse thick middle ear discharge of two weeks duration, the fever, the mastoid tenderness and positive roentgenologic findings, a simple mastoidectomy was performed under avertin anesthesia. Pus under pressure was found immediately on removing the mastoid cortex. The mastoid bone was the seat of widespread disease. Necrotic granulations had formed between the cartilaginous and bony canal since the removal of the foreign body, which were removed. The mastoidectomy was completed and the external auditory canal firmly packed.

Forty-eight hours after operation there was a recurrence of the facial erysipelas which was again treated with ultra-violet rays. The profuse discharge from the middle ear and mastoid wound gradually diminished. Twelve days later the patient was referred to our Out-patient Department ear clinic for dressings. The

follow-up report six months later showed "that the mastoid cavity was healed, and the middle ear discharge scant." The mother stated that, "the ear began to discharge again only after the child had a cold."

COMMENT. This three year old child was in the hospital for almost seven weeks. She had three general anesthesias, one postauricular incision for the removal of the foreign body, a simple mastoidectomy, scarlet fever and two bouts of erysipelas. This sequence of events strikingly illustrates some of the serious complications one may encounter in the treatment of aural foreign bodies.

DISCUSSION

Complications can often be avoided if certain basic principles are borne in mind. Of great importance according to Richards,[14] Keen,[1] Asherson,[3] Myers[18] and others is the necessity of good reflected light in carrying out any manipulations. Because foreign bodies occur frequently in young children in whom one cannot rely on complete cooperation, it is advisable to administer a general anesthetic before attempting removal. A struggling, insecurely held child is apt to move at an inopportune moment and cause trauma to the external auditory canal with resultant bleeding and swelling, thus making a potentially simple procedure quite difficult. On the other hand, one must remember that an anesthetized child cannot indicate when the surgeon may be causing trauma possibly of a serious nature.

After the patient is anesthetized forcible irrigations should always be tried first, provided, of course, the tympanic membrane is intact and that the foreign body is not hygroscopic. The nozzle of a good strong ear syringe covered with a soft rubber tip should be inserted into the external auditory canal close to the foreign body, directing the stream of warm water between the foreign body and the canal wall. The external auditory meatus should be straightened out by pulling the auricle upward and occasionally it is helpful if the mouth is agape. In most cases this procedure will suffice to dislodge and remove the foreign body. Zaufal, quoted by Dimitriadis,[7] was able to remove 92 of 109 foreign bodies from the ear by syringing, and these statistics are similar to those of Schwartze and other authors.

Should this method fail, we must consider the other methods at our disposal. It is manifest, from the variety of foreign body one may encounter, that no inflexible rules can be dogmatically formulated, as to how to proceed. We do feel that intrameatal manipulation with instruments should be performed by the specialist rather than by general practitioners. The anatomic configuration of the external canal varies in different individuals. The size, shape and physical characteristics of the foreign body, the length of time it has been in the external auditory canal, the presence or absence of swelling, bleeding, otorrhea or stricture at the isthmus, are all factors which indicate which is the method of choice to follow. Whether to operate or to apply wet dressings and await the subsidence of the acute inflammation, can, in the last analysis only be decided by the otologist observing the patient at the time.

Foreign bodies which swell, such as beans, peas or seeds, should be treated promptly by repeated instillations of absolute alcohol into the external auditory canal, to cause shrinkage of the hygroscopic foreign body. When this has been accomplished, one can frequently dislodge the hitherto fixed foreign body by inserting a bent silver probe between it and the canal wall. We must heed the caution of Richards who advised against using force from below upward when an object is deep in the canal, since it is possible to push the object into the middle ear or attic. Occasionally it may be advantageous to break this type of foreign body and remove it piecemeal with a forceps. Care must be exercised to remove all of the foreign body.

We do not like to use sharp hooks because of the danger of injuring the external auditory canal. When their use is unavoidable, the sharp point of the hook should be seen all the time thus lessening the likelihood of trauma. A tooth, irregular glass objects or pieces of crockery can frequently

be grasped with a small-toothed forceps and removed by gentle manipulation under direct vision. On the other hand when smooth hard foreign bodies, like pearl beads, are grasped with toothed forceps they tend to slip away and are often forced deeper into the external auditory canal. If undue force is used the foreign body which was originally situated close to the external auditory meatus, may be thrust deep into the osseous canal, or even into the tympanum. Trauma of this extent can cause dislocation of the ossicles, hemorrhage, facial paralysis or injury to the laryrinth. It is amazing how readily a foreign body will in certain positions pass into the external auditory canal and how difficult, after it changes its position, it becomes to remove it until it is manipulated back into the original position in which it entered.

CONCLUSIONS

The factors of paramount importance in the removal of foreign bodies in the external auditory canal in children, are that all manipulations be performed under a general anesthesia. Good illumination, preferably reflected light, is a necessity. No attempt at removal should be made, to quote Richards, until prepared to cope with any situation which may arise. Hygroscopic foreign bodies require removal at the earliest moment but should be treated with absolute alcohol before any efforts at removal are undertaken. The method of choice in the removal of non-hygroscopic foreign bodies, is that of forceful syringing with warm water or solution of boric acid, provided there is no perforation in the drum.

Syringing having been tried repeatedly under general anesthesia, or being contra-indicated, the physical properties of the foreign body will then determine whether one uses blunt curettes, blunt or sharp hooks, silver probes, forceps or whatever instruments are available. After removal of the foreign body, ammoniated mercury ointment 5 per cent should be applied liberally to the walls of the external auditory canal.

In those instances in which it becomes necessary to employ a postauricular incision in order to remove an impacted foreign body which is causing severe symptoms, one must pack the external auditory canal firmly postoperatively to avoid atresia. If the middle ear is discharging it is safer to risk an atresia by not packing then it is to pack and court an otitic complication.

REFERENCES

1. Keen, J. A. Foreign bodies in the ear and nose. *Jour. Laryng. and Otol.*, 45: 333–343 (May) 1930.
2. Politzer, A. Diseases of the Ear. Lea & Febiger, Philadelphia, 1926.
3. Asherson, N. Foreign bodies in the external auditory canal. *Clin. Jour.*, 61: 110–113 (March) 1932.
4. Zaufal, E. Quoted by Dimitraidis. Uber Fremdkörper im Menschlichen Ohre. Athens, P. D. Sakillarios, 1909, p. 139, 195.
5. Lucae, A. Fremdkörper des Ohres. Eulenberg's Real Enzyklopädie der Gesaamten Heilk, Urban and Schwatzberg, 5: 398–404, Wien and Leipzig, 1881.
6. Wells, J. L. Foreign body removed from ear after 33 years. *Brit. Med. Jour.*, 2: 637–638 (Oct. 8) 1927.
7. Dimitriadis, D. S. Uber Fremdkörper im Menschlichen Ohre. Athens, P. D. Sakillarios, 1909.
8. Abdulla, M. Foreign body as a cause of persistent hiccough. *Indian Med. Gaz.*, 65: 445–446 (Aug.) 1930.
9. Fabricus v. Hildanus. Quoted by Politzer, Geschichte der Ohrenheilk. Stuttgart, F. Enke, 1: 153–154, 1913.
10. Foster, B. A tick in the auditory meatus. *Med. Jour. Australia*, 18: 15–16 (Jan. 3) 1931.
11. Chavanne, L. Vertige et Cepholee par Corps Etranger de l'oreille y sejournant depuis vingt ans. *Oto-rbino laringo internat.*, 19: 69 (Feb.) 1935.
12. Kennedy, W. P. Foreign body in ear for 36 years. *Brit. Med. Jour.*, 1: 14 (June 7) 1928.
13. Hilton, G. E. M. Foreign body in the external auditory canal. *Can. Med. Assn. Jour.*, 33: 308 (Sept.) 1935.
14. Richards, G. L. Foreign bodies in the external auditory canal. *Am. Jour. Surg.*, 6: 514–516 (April) 1929.
15. Seshachalam, T. Unusual foreign body (scorpion) in external auditory canal. *Indian Med. Gaz.*, 62: 145 (March) 1927.
16. Chalier, J. and Rousset, J. Foreign body in the external auditory canal causing tetanus in a child 3 years old. *Lyon Med.*, 141: 675 (June 10) 1928.
17. Brian, R. Translation of Chirurgie de Paul D'Egine. Paris, v. Masson, 1855. Chap. 24, pp. 143–145.
18. Myers, G. L. Removal of foreign bodies from the aural canal. *Jour. Kansas St. Med. Soc.*, 34: 351 (Sept.) 1933.

INCISIONS OF DRUM MEMBRANE IN OTITIS MEDIA*

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INCISION of the drum membrane, commonly known as myringotomy or paracentesis, is one of the earliest operations practiced by the otologist. Judging from the satisfactory results obtained from this procedure its value cannot be overestimated. In the course of time, with our increase in knowledge of the clinical and pathologic conditions of the tympanum, mastoid, and their adnexa, the indications for myringotomy have naturally undergone changes. While in the majority of conditions of the middle ear there is agreement among otologists as to the indications for myringotomy, opinions may differ as to the precise time of carrying out this procedure. It is agreed that a knowledge of the surgical anatomy of the tympanic cavity as well as the pathology, physical signs and symptoms of otitic infections are prerequisite and most essential to the otologic surgeon.

ANATOMY

It is not the purpose of this paper to enter into a discussion of the minute anatomy of the tympanum, only those features which have any bearing upon the operation will be considered. It must be remembered that the tympanic membrane is a transparent concave oval disc, about 0.1 mm. in thickness. It forms an oblique angle of about 55 degrees with the horizontal plane, so that its upper border is closer to the auricle than is the lower border. An outstanding landmark of the tympanic membrane is the hammer handle, the lower margin of which is situated at the umbo. The latter is the site of the greatest concavity. Situated at the upper anterior part of the drum is the short process of the malleus which jets out rather prominently. From this structure there are two striae, one running upward and forward and the other upward and backward to the margin which inclose the flaccid part of the drum known as Shrapnell's membrane. The remainder of the drum is tense and is known as the pars tensor. From the umbo a cone of light extends downward and forward to the margin.

It must also be borne in mind that the distance between the tympanic membrane and the inner tympanic wall is relatively small, measuring only 2 to 4 mm.

Histologically, the tense portion of the drum is comprised of three layers; (1) an outer cutaneous layer, (2) a middle fibrous layer consisting of outer radiating and inner circular fibres, and (3) an inner mucous membrane layer.

In infants the tympanic membrane is practically of the same size as in the adult.

PATHOLOGY OF ACUTE MIDDLE EAR SUPPURATION

As is well known, suppurations of the tympanum are most frequently secondary to infections of the nasopharynx, extension taking place by way of the eustachean tube. In the early stages there is swelling of the mucosa lining the tympanum with engorgement of the vessels. This is soon followed by an extravasation of exudate. The exudate at first is serous or serosanguinous, but later assumes a purulent character. These changes in the tympanum usually make themselves manifest on otoscopic examination by progressive changes in the drum. As a result of the accumulation of the purulent exudate, the tympanic mem-

* From the Otologic Service of Dr. Friesner of the Mount Sinai Hospital.

brane bulges out until rupture finally takes place. It must be borne in mind that this ballooning out cannot always be ascribed to the mechanical pressure of the purulent exudate within the tympanum; it may be secondary to a marked thickening associated with inflammatory changes within the drum itself. This, in all probability, is an important factor in the production of localized areas of fulness so frequently seen, instead of the diffuse bulging of the entire drum.

While the appearance of the drum on otoscopic examination is usually an index as to the nature of the pathologic process within the tympanum, at times, owing to either a markedly thickened membrane or to previous scarring, the two conditions do not correspond. Hence a severe inflammatory process may exist in the tympanum without corresponding changes in the drum membrane.

There is strong evidence in favor of the view that suppuration in the tympanum is not always secondary to infection in the nasopharynx or eustachean tube. This is particularly true in the acute infectious diseases as measles, scarlet fever, etc. Here, in all probability, the mucous membrane of the entire upper respiratory tract including the tympanic cavity is simultaneously involved through the blood stream. The otitis produced in this manner may show no characteristic clinical or pathologic features and the indications for myringotomy here differ in no way from those in the usual infections.

In a consideration of the pathology of middle ear suppuration it must be emphasized that the tympanum, aditus and antrum are in reality one cavity. With practically every infection of the tympanum there is simultaneously or shortly thereafter a more or less corresponding condition in the aditus and antrum. One must even go a step farther and state that with every suppurative process in the tympanum and antrum there is usually a concomitant involvement of the mucosa lining the pneumatic spaces of the mastoid and of the petrosa. This involvement consists of thickening of the mucosa with engorgement of the vessels, which in the majority of instances subsides. While the significance of these pathologic changes in the temporal bone are quite apparent they must not be construed by themselves as indicative for early myringotomy.

PHYSICAL SIGNS AND SYMPTOMS

Signs and symptoms of acute middle ear suppuration vary with the individual case. As a rule there is first seen a congestion of the vessels of the drum membrane. This is soon followed by redness, thickening and some fulness. By this time the light reflex is obliterated. With the increase of fulness the other markings such as the hammer handle, the folds of Shrapnell's membrane and finally the short process gradually disappear. The red discoloration may assume a yellowish tint, particularly at the site of greatest tension.

In the course of development of these signs, the patient complains of fulness in the ear, pain varying in intensity, usually sharp or sticking, increased by motion of the head, and diminution of hearing. Tenderness over the mastoid is not infrequent at an early stage of the infection. The temperature may be only slightly elevated. In children, however, an elevation to 104 or 105 degrees F. is not unusual. Here also the other symptoms are more pronounced so that vomiting, general debility, and even convulsions may be present.

INDICATIONS

No hard and fast rules can be set down regarding the exact indications for myringotomy. Each case must be evaluated on its own merits. Naturally the physical signs and symptoms constitute most important criteria in deciding upon the time of operation. In addition, however, factors such as the type and virulence of the organism, method of extension, the age, the general condition and temperment of the patient must be taken into consideration. In the

presence of a bulging drum with all the landmarks obliterated, with pain, tenderness over the mastoid, and impaired hearing, there can be no question as to the advisability of a paracentesis. An ear with findings such as these seldom goes on to resolution without discharge, either spontaneous or by incision. All of these classical symptoms need not be present, however; severe pain or marked postauricular tenderness associated with rapidly progressive changes in the drum may be considered sufficient evidence to warrant incision. A principle which we have followed on the otologic service of The Mount Sinai Hospital is that a myringotomy is performed when on otoscopic examination all landmarks of the drum including the short process have disappeared. This structure is usually the last to be obliterated. A drum presenting such a picture even in the absence of other physical signs or symptoms warrants incision. The desirability of applying this principle is demonstrated by the fact that in the vast majority of instances with such findings frank purulent exudate is obtained.

As is well known, in some epidemics of upper respiratory infections or of the acute infectious diseases the invading organism shows a particular affinity for the middle ear. One soon learns by experience the peculiarities of the particular infectious process. Here, when rapid progress of the infection in the middle ear is observed, one is justified in doing a myringotomy somewhat earlier than usual, particularly if the patient cannot be under very close observation.

Again, in the elderly patient with diabetes or with other debilitating disease, where it is well established that infections spread with great facility, a myringotomy at a time somewhat earlier than that commonly agreed upon is indicated. In the same category may be placed the suspected pneumococcus type 3 infections of the ear where the degree of impaired hearing is usually out of proportion to the other physical signs. Here, the infection, although of a slow and insidious nature, progresses with destructive tendencies and often involves the intracranial structures.

In isolated instances where the temperature remains elevated or where there is evidence of continued sepsis and when the cause of these cannot be ascribed by the internist or pediatrician to any condition other than to the ear, one is justified in incising the tympanic membrane. This should be done even though the appearance of the drum and the otitic symptoms are not quite those which would warrant it under ordinary circumstances.

Of particular interest is the type of otitic infection which is not infrequently observed at the outset of a lobar pneumonia, especially in children. This is characterized by a reddish pink drum which goes on to diffuse thickening but with very slight if any bulging. The landmarks disappear very slowly. The child complains of pain in the ear, and the condition is most often noted by the pediatrician in the routine examination. At the height of infection, the short process is barely visible through the thickened membrane. It has been our experience that this type of infection usually resolves spontaneously without rupture and does not require myringotomy. In these cases there are the usual symptoms of pneumonia. On occasions the correct diagnosis of lobar pneumonia has been suggested on otoscopic examination by the appearance of the tympanic membrane even before frank signs in the chest have become demonstrable.

For a time there was a difference of opinion among pediatricians and otologists with regard to indications for myringotomy, and even mastoidectomy in the severe gastrointestinal intoxications in infants. This was due to the fact that the basis upon which the indications were established rested, on the one hand, chiefly on the general physical condition of the patient, and on the other hand chiefly on the otitic condition. The tendency now is, and I believe rightfully so, to be guided more and more by the otoscopic findings

but always bearing in mind the general condition of the patient.

In the so-called influenzal or "grippe" otitis the outstanding feature is the presence of hemorrhagic blebs on the drum and in the external canal. These blebs vary in size and are usually associated with considerable pain. They may appear very early in the otitis and very frequently rupture before the landmarks on the drum have fully disappeared. A serosanguinous discharge from rupture of the blebs may be misconstrued by the patient as evidence of spontaneous rupture of the tympanic membrane. The presence of blebs should not influence the indications for myringotomy one way or the other. They usually require no special treatment. However, on occasions, incision of these alone affords the patient a considerable amount of relief of pain.

Repeated myringotomies are seldom necessary if the original incision is properly made. Such an opening rarely closes prior to the time it has served its function of drainage. The fact that the membrane occasionally continues to bulge after incision or even after the opening has been sealed over must not be considered evidence of retained purulent exudate under pressure. It may be due, as was previously mentioned, to inflammatory changes within the drum itself, changes which are relatively slow in resolving.

The question might be raised, after the indications for myringotomy have been established, what are the hazards, if any, in waiting for spontaneous rupture? The answer to this question is included in the following outline of the advantages of myringotomy.

1. Immediate relief of symptoms is frequently afforded.

2. The likelihood of extension of the infection to the mastoid and adjacent structures is diminished.

3. Toxic absorption from a purulent focus is lessened.

4. Spontaneous rupture is not always followed by adequate drainage nor does rupture always occur at the site of choice.

5. The principle implied in the dictum "where there is pus it should be evacuated" is maintained.

On the other hand, incisions of the drum made too early are not always free from an element of danger. Under these circumstances sufficient time has not elapsed for adequate walling off of the infectious process. Instances of intracranial complication attributed to too early incision have been recorded.

Preparation of Patient for Myringotomy. The external canal must be prepared by careful cleansing with peroxide of hydrogen or alcohol. Adequate illumination is very important, the reflected light is to be used whenever possible. The funnel of the aural speculum should be of the largest size admitted by the external canal. If the patient be an infant, below the age of two and one-half or three years, proper "mummification" in a sheet and careful holding are most essential. An anesthetic here is usually not required. In children above this age, and in adults, a general anesthetic is advisable, gas and oxygen or ethyl chloride proving most satisfactory. The blade of the myringotomy knife must be razor sharp.

Site of Incision and Technique of Operation. The site of choice for incision is the posterior inferior quadrant. This is based not only on a consideration of the anatomy of the tympanum but also on clinical experience. A study of the anatomy will reveal that the corresponding structures on the inner tympanic wall if projected from the tympanic membrane are, (1) the anterosuperior quadrant with the tympanic opening of the eustachean tube; (2) anteroinferior quadrant with the carotid canal; (3) postero-superior quadrant, long process of the incus, stapes, oval window, etc. and (4) postero-inferior quadrant, promontory.

It is obvious from this description that the most favorable site for incision and the least hazardous is the postero-inferior quadrant. The promontory situated here

projects outward and protects the underlying secondary tympanic membrane against trauma. The danger, although remote, of striking the jugular dome which occasionally protrudes into the hypotympanic cavity and which frequently presents dehiscences must always be borne in mind.

A curved incision parallel to the external canal wall and extending from 9 to 6 o'clock, or from 3 to 6, depending on the side, is made. This type of incision has the advantages over the linear one in that it is larger and it includes a greater number of the radial fibres of the drum. The retraction of these severed fibres keeps the wound open; better drainage is thus obtained. Incisions made in the postero-inferior quadrant have also proved most satisfactory in instances where the greatest expression of fullness is manifested elsewhere in the tympanic membrane. Under such circumstances the inflammation resolves in the usual manner without evidence of undue scarring in the drum.

Cultures of the pus from the middle ear at the time of myringotomy should be made routinely. Valuable information with regards to prognosis and subsequent therapy is often obtained.

After Care. Following incision it is advisable to carefully irrigate the ear with warm saline or boric acid solution, once or twice within the next eight hours, to remove the blood clots from the margins of the perforations and from the external canal. This is to be followed by dry wiping of the canal with cotton swabs as often as necessary. The local application of heat and the use of a sedative usually suffice to keep the patient comfortable.

While in the vast majority of instances myringotomy affords almost immediate relief of symptoms, occasionally, however, particularly in the rapidly advancing infections and when this procedure is done prematurely the symptoms may continue. Also, it must be remembered that the spread of infection to the adjacent structures is not always obviated by this procedure.

SUMMARY

The surgical anatomy of the tympanum, the pathology, physical signs and symptoms of acute middle ear suppuration in the most common forms are briefly outlined. A clear understanding of all these factors, together with one's clinical experience, forms the basis of the otologist's judgment in the decision for or against myringotomy. Naturally the general condition of the patient must always be considered. It is for this reason that the close cooperation between the pediatrician or internist and the otologist is most essential.

TREATMENT OF BOILS AND CARBUNCLES

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BOILS and carbuncles form a scourge which must have afflicted the human race from prehistoric times, yet little effort appears to have been expended in any movement to diminish their prevalence during this period, other than to allay the local discomfort which commonly accompanies their presence.

The laity accept the first seven boils philosophically as Nature's method of ridding the blood of some noxious humor; and endure them as they do taxes, not always patiently, but as a necessary evil to round out life's experience of human suffering.

The medical profession seems to have assumed a similar attitude, overlooking a fountain source of staphylococci which is maintaining and spreading virulent organisms with a specific pathogenic selectivity for skin, the largest protective barrier of the body except the blood.

What happens to the staphylococci which are so commonly found in skin infections to cause them to become the active organisms of grave complications by invasion and dissemination within this natural protection, even in the absence of active skin lesions, has never been satisfactorily explained.

It is evident from the past history of both these skin and systemic infections, and our inability to prevent and control their recurrence adequately at the present, that preventative medicine and surgery are at fault in handling this problem. It, therefore, becomes our surgical responsibility to make an effort to lessen the recurrence, and hence the incidence of boils and carbuncles on patients being treated for them.

A great opportunity would seem to be afforded surgical research for the development of procedures which might diminish this great source of staphylococci. A concerted attack on these two common and related lesions by preventative medicine, surgery, and bacteriology, should bring results of great and far reaching value.

Fifty-seven years ago the typhoid bacillus was unknown. From a disease which at that time caused an enormous death rate, it has at present become too infrequent to afford enough cases to teach the disease and its complications to medical students. This has been accomplished through practical sanitary measures, of vaccination, disinfection of bacilli carrying excreta, and isolation of carriers. All this developed in the period of time mentioned. The same may be said of diphtheria and other diseases.

Surgical departments could readily spare the required time from delving into obscure cavities of the body for rare and occult pathological lesions due to complications of the lowly furuncle to direct investigation toward diminishing this skin infection which might lead to an arrest of some of the ravages in the body due to staphylococcus infection. Organized research while seeking new diseases to conquer, should give at least passing attention to the prevention and cure of these ancient but still existing afflictions of man with the possibility in mind of their being one of, if not the great fountain source of all staphylococcus infections pathologic to man.

Curiously enough it appears necessary to have a high mortality attached to a disease to attract medical and lay effort to a study for checking its prevalence and progress; and when a conquest is assumed to be in prospect, the success of the means used to accomplish this end, is rated in terms of lowered mortality. It is obvious that this yard stick would be most difficult to apply to boils, though easily applicable

to carbuncles. The mortality of boils in hospital records however, is concealed in the enormity of the catastrophe of their lethal complications, caused through disseminated infection.

I believe the incidence and mortality of carbuncles are connected in a large degree with the furuncle bearer by his contribution of organisms with increased virulence and specific action to which is added his ignorant disregard of elementary principles of surgical cleanliness.

The prevention of the initial boil or carbuncle, I doubt can be avoided; but I am sure by painstaking energetic efforts, its incidence can be diminished, if the local spread and recurrence of cases of furunculosis which one sees and which have continued for several years, can be checked in a few weeks by simple surgical measures at present in use. Further knowledge regarding the pathological customs of the staphylococcus might help bring about the elimination of the staphylococcus carrier, who is disseminating infection to those with a low immunity. These becoming infected in turn pass on organisms of increased virulence which having developed specific action for the skin, do not necessarily confine their activity to this structure. Each small detail which can be added to the prevention of this cycle, will be an aid in diminishing the contaminating influence of the vast surface of bacteria bearing skin to which every human being is exposed and contributes daily.

That a person may contaminate the air with staphylococci is supported by data in an article by William and Mildred Wells[1] on "Air borne infection (sanitary control)" who find that the "organisms in the tubes taken at the Children's Hospital, Boston, both before and after irradiation of the air were observed to be predominately sarcinae and staphylococci, owing to the nature of the activities of the clinic. These organisms are characteristic of the skin and were raised into the air by the dressing and undressing of the patients, together with the treatments which consisted largely of massage, manipulation, exercises, and so on." Earlier in this same paper, they state that "the Staphylococcus aureus and albus found in this study of air borne infections were more resistant than B. coli and Streptococcus veridans, and exceeded only by sarcina lutea in their resistance to ultraviolet radiation." Although the pathogenicity of these organisms was not worked up, these are very suggestive facts as an expression of the organisms resistance to destruction.

The important role that the staphylococcus plays as compared with other organisms when it involves the osseous structures, as an example of systemic invasion, is clearly shown in an article by Robertson[2] on osteomyelitis. A staphylococcus was found singly in 69.3 per cent of the cultures, and once in combination with streptococcus, and singly in 24 per cent of the blood cultures, and once in combination with streptococcus.

It would appear that concerted vigorous attack on infections of the skin due to these indigenous organisms might offer some relief from the many serious diseases with their high mortality which staphylococci cause in other deeper structures of the body. Attention seems to be concentrated on the most suitable operative procedures for a disease, the predominating causative organisms of which are known, with a casual disregard for the most apparent and fertile source of these. It is similar to the treatment of malaria before the mosquito was found to be the carrier of the infection.

I have indicated the need of preventing the spread of bacteria from a contaminated surface of one person to another. There is a more important need in preventing the spread of infection from any one single lesion to other parts of the same person to establish prevention and cure. The degree of meticulous care given the first lesion

[1] Wells, W. F. and M. Air-borne infections: sanitary control. *J. A. M. A.*, 107: 1805 (Nov. 28) 1936.

[2] Robertson, R. C. Acute hematogenous osteomyelitis. *J. A. M. A.*, 107: 1188 (Oct. 10) 1936.

seen by the physician not infrequently determines the duration of the disease.

The first lesion on the patient is rarely seen by the doctor. It is usually treated by the patient himself after consultation with the local pharmacist or "amateur quack." Until surgery offers better, this will continue so, or until some one climbing out of the rut will take notice of these old diseases and dramatize them sufficiently to attract professional and lay attention to their very probable important etiological relationship to all forms of staphylococcus infection with its high disability and mortality rate.

The individual is rare indeed upon whom some small follicular infection cannot be found, manifested in the redness about the opening of a hair follicle, sweat or sebaceous gland. The role these minute infections play in initiating and spreading the more important one to subjects with lowered immunity, will be a hard nut to crack; but I feel this will be done in the future by coordinated laboratory and clinical studies. That there is a relationship, appears suggestive in the degree of folliculitis seen in proximity to an established skin lesion under treatment, especially in areas sparsely covered with hair. Though we cannot request a patient to seek medical care for a pimple, it is incumbent upon every medical man to carefully treat and protect such small areas of infection to prevent spreading of it and recurrence of larger ones until immunity has been established. That such an immunity exists and is an important factor in overcoming gross infection is demonstrated by two facts, the self limited duration of so many cases which receive very poor attention; or the more important one, that every boil or carbuncle does not cause death, with or without treatment. Individuals who have manifestly a low resistance against skin infections should be taught to use every precaution against it until the cause of this lowered resistance has been corrected, or age has lessened their susceptibility sufficiently to prevent relaxing this vigilance. The diabetic should use this care throughout life.

There are more closely related etiological factors which are so intermingled with treatment that for brevity sake, I will discuss them in their place. I will emphasize important features which have to be anticipated or treated during any stage of the treatment of furunculosis or carbuncles, as they may cause or follow each other.

The blond sandy complexioned individual whose skin becomes red from slight irritation, we cannot change. He requires that great care be taken to avoid any irritation or injury of the skin by solutions or dressings to avoid spreading the infection to adjacent parts; and careful attention to hygiene, adequate physical rest and protection against extraneous infection as well as his own. Anemia should be corrected, and the carbohydrate intake adjusted to actual requirements to avoid excess. This does not refer to the diabetic who requires closely observed, skilled diabetic care. Garments worn next to the skin should be of non-irritating texture, changed daily, and boiled or adequately washed and rinsed between changes. This holds good for all athletic garments worn during exercise. Avoid swimming in water contaminated by many bathers, followed by lounging on dirty sand beaches. The value of sunlight in improving the resistance of the skin is overshadowed by contamination and trauma by contact with sand. Youths should be cautioned against the careless use of unclean towels at boy's clubs, schools, or public swimming pools, etc. Until very recent years, the frequent disability of collegiate rowing crews was recorded in the daily press. Contaminated wrestling mats have made their contribution. All parts of athletic apparatus exposed to contact with perspiring parts of the body should be wiped with 1 per cent formalin solution frequently enough to avoid accumulation and transmission of infection. Lubricating oils have been found to cause an epidemic in workers about machinery. A person with furuncles should use every precaution

against contacts with other people, a precaution which others should see is carried out, especially in industry and in the home.

The cellular mass killed by staphylococcal infection may be small enough to quickly liquefy and near enough to the surface to merely form a drop of pus beneath the epidermis. This may dry up, form a crust which is rubbed off and onto another part of the body. The infection may pass deeper, destroy a mass of tissue of variable size, in which case it becomes a necrotic mass or slough which as it separates from the healthy tissue, liquefies as pus; pressure and pain develop, and through necrosis of the overlying tissue the pus may spontaneously evacuate itself relieving pain by diminishing tension. Tenderness, pain, and toxemia continues until all the slough becomes separated, which Nature accomplishes in about ten days. Coincidently with the complete separation of the slough, pain and tenderness and the purulent discharge cease, and there is left a granulating cavity to be filled. *Until this cavity has granulated to the surface it discharges infected serum*, and continues to do so until the surface of the granulation tissue is epithelized, not closed with a crust which is formed from the infected serum. These crusts tend to prevent healthy granulations filling the existing cavity by preventing drainage. When desquamated these crusts become the most important carriers of infection to other parts. A slough once started, I believe takes ten days of healing period from its inception until it is separated sufficiently to be expressed. If deep, this necrotic mass becomes completely liquefied after an adequate time period. The pus from a lesion near the surface may be evacuated by necrosis of the overlying tissue; but if deep, it will necessitate drainage by incision. If the foci are multiple and extensive, the subcutaneous tissue is involved and the infection spreads until tension is released by adequate drainage, or the process progresses and a carbuncle forms.

On this brief pathology, the treatment is based. A small lesion can be completely excised, and the wound left open for drainage and healing; but such a procedure is not advisable, as the protective barrier is removed and the infection left in the lymphatics affords a better chance for systemic invasion. When a boil is incised before an adequate liquefaction of the slough has occurred, the protective zone is injured and a new slough forms on the edge of the incision which will take several added days to separate. The boil which has advanced to a point of partial liquefaction surrounded by a better protective zone, can be incised with less danger of disseminating infection and a minimum of sloughing along the incision which delays convalescence.

The all important requisites to the treatment of a boil or carbuncle are (1) primarily to promote liquefaction of the slough; (2) to give early drainage for the pus under pressure and maintain it as is indicated in any abscess; (3) to prevent the discharge from spreading the infection, and to aid in increasing the local and systemic resistance.

Nature's method of affording drainage is by necrosis of the overlying tissues, which can be aided by moist heat, keratolytic drugs such as salicylic acid ointment of from 1 per cent to 5 per cent, or incision. Moist heat can be applied in the form of sterile compresses wet with hot boric acid solution, or Thiersch's solution covered with cellophane to prevent evaporation. Saline though comforting, as it becomes concentrated, tends to cause additional folliculitis if kept up for any period of time. Magnesium sulphate solutions rapidly become concentrated, leaving a rigid encasement of irritating crystals which lend nothing to the comfort of the patient nor cure of the disease. Magnesium sulphate is one of the good drugs which in recent years has been prostituted from its proper pharmacological use as a cathartic to the role of a placebo unworthy of surgeons. Salicylic acid 1 per cent in boric ointment U.S.P. No. 11, is a soothing antiseptic ointment which should be used on the contigu-

ous skin surface to prevent folliculitis and additional boils, or applied generously over an incised lesion beneath either wet or dry dressings when these are used, prevents coagulation of exudate which interferes with drainage. This is especially valuable when laxity permits wet dressings to become dry.

When more energetic softening of the superimposed tissue is indicated, to open an existing pustule, Klotz's formula of salicylic acid in the form of an emplastrum as given in Brewer's "Text-Book on Surgery,"* is most valuable. I have used it for a great many years to afford drainage of small pustular lesions, protection against and treatment of folliculitis, and to prevent an infection from spreading. This emplastrum offers the simplest and most efficient dressing for small single or multiple lesions one can use. It affords the only method of which I know for patients to protect themselves against small follicular infection, preventing recurrence, and larger ones. This emplastrum is used by melting a small amount on the point of a spatula over a flame, dropping this in the center of a small circular piece of adhesive plaster, and while still melted it is flattened, then allowed to cool to a dull lustre to avoid causing a blister in which the pus will collect. This "paster" is then applied to the lesion after all the hair has been removed by shaving with a sterile razor and cleansing with alcohol. To remove this paster, the margin is grasped with sterile forceps and a small cotton ball soaked in benzine held in another pair of forceps is used to float off the paster. Under no circumstances should the trauma of pulling this paster off be permitted, as doing so injures the mouths of glands and hair follicles and predisposes to infecting them. After removal in this manner, the benzine is wiped away with alcohol, or witch hazel which is more soothing. If the surface requires cleansing, use a little hydrogen peroxide in tincture of green soap, followed by alcohol again. These pasters are used to cover a very small isolated but tender follicle infection. If gentle pressure on the paster elicits tenderness after twenty-four hours, it is changed for a new one, otherwise they are left on for several days before removal, at which time the infection will have subsided. In the case of a draining or moderately large lesion, they are changed daily or even twice a day if the drainage is enough to show at the margin of the paster. Under this dressing, a small furuncle will open and drain without contaminating the surrounding parts. The pasters are continued, changed as indicated, and left on until the wound is healed by complete epithelization, which it will do in contact with the salicylic paste. As I have suggested above, an infected crust from a so-called healed lesion dropped on the skin and rubbed with the clothing will reinoculate like the old method of vaccination with the crust of cowpox.

Patients with arrests of infection are instructed to equip themselves with the necessities for these procedures and to apply a paster on any pimple or red area which develops in the future. Any and all procedures connected with the caring for the condition must be carried out meticulously by the doctor and patient, and with the same interest that they give their game of golf.

I have taken this up at length, because I believe it to be one of the greatest adjuncts to the treatment of boils and carbuncles in eradicating autoinfection at present available. I have been grateful for its aid for twenty-five years.

* The pharmacist from whom I obtain the modified emplastrum Klotz has kindly suggested that after the ingredients are melted by heat and mixed by stirring, the mixture is allowed to cool to half the temperature required to melt them. The mass is then kneaded under water with the hands, and when cool and solid enough, it is rolled into cylinders 6 cm. long and 1.5 cm. in diameter, as a convenient size for use.

MODIFIED FORMULA OF EMPLASTRUM KLOTZ

Emplastri plumbi	60.0
Emplastri saponis	25.0
Petrolati	8.0
Cerae alba	20.0
Acidi salicylic	5.0

A lesion which is not draining and whose size and depth preclude the use of emplastrum salicylate Klotz, or in which the tension is associated with tender lymph nodes, incision is indicated and should be opened under a local anesthetic. Local anesthetics injected by direct infiltration into the induration of a boil cause pain by tension until the anesthetic takes effect, and five minutes should be allowed for it to act. Where the tissues permit, blocking is more desirable. The ethyl chloride spray used to freeze and harden the surface over a tender boil, followed by pressing on the frozen surface with a dull knife, is a poor form of local anesthetic. In blocking carbuncles great care and judgment should be used to avoid spreading infection with the injecting needle, and a general anesthetic is preferable if the patient is a suitable risk.

A boil which has been adequately incised at the right time, will require no more than a piece of rubber dam for a drain, aided by 2 per cent salicyclic acid ointment to keep the incision open. When the slough extrudes sufficiently to act as a drain, do not pull it out, but see that it does not prevent drainage. When it is separated, it will fall out on the dressing. Using large thumb forceps to force gauze wicks into these small openings is a cruel and unnecessary trauma and affords poor drainage; use fine non-toothed eye forceps to introduce the rubber dam.

Areas surrounding any of these lesions should be shaved sufficiently to prevent adhesive plaster used in dressings adhering to any existing hair. Benzine again should be used to float off such adhesive followed by alcohol and careful cleansing with hydrogen peroxide and green soap. There are skins which develop a slight redness showing a sensitiveness to any irritation. These should be treated with calomine solution without carbolic acid until the irritation has subsided.

This covers the general principles of treatment for lesions on any part of the body except specific regions which call for special procedures in conjunction with the above. The region within the area enclosed by a horizontal line extending through the external canthi of the eyes, one through the angles of the mouth, and two vertical ones connecting the canthi and mouth angles may contribute infection to the cavernous sinus via the angular, ophthalmic, and other veins. Therefore any pyogenic infection of this region is of major importance in its relation to causing cavernous sinus infection and thrombosis. Walton Martin[3] has reported a mortality of 6 of 7 cases of infection of the upper lip and nose admitted to St. Luke's Hospital, New York. The 6 that died had been pricked, cut, or squeezed. He emphasized the need of using atraumatic procedures to avoid complications by injury to the small veins about the lesion which are thrombosed. Batson[4] of the Graduate School of Medicine, University of Pennsylvania, has demonstrated on the cadavar that ligation of the angular vein does not prevent substances injected into the facial vein being carried into the cavernous sinus by several other routes. This has removed a great burden and confusion in my own mind regarding whether it should or should not be done in the presence of infection in this region, and when. I have always felt that it was unnecessary trauma of doubtful value in a dangerous region. The burden of proof in its favor has still to be proved by those advocating it.

The specific technique for caring for furuncles and carbuncles of the nose, upper lip, and face in the above region is as follows. The patient is placed in a hospital bed in the sitting position, body high, to avoid swelling of the face and the knees flexed to prevent slipping down; this position is maintained day and night. Along side of the bed, a table is placed on which is an electric plate with switch under the patient's control. On this there is a basin of boric acid solution which is kept hot.

[3] Martin, Walton. The fatal outcome of certain cases of staphylococcus infections of the face and lips. *Ann. Surg.*, 76: 13 (July) 1922.

[4] Batson, Oscar V. Oral communication from unpublished studies of "Anatomy of the Head."

Salicylic acid 5 per cent in boric acid ointment (without wax) is well rubbed into several layers of a gauze pad, leaving an excess on the surface. Then the heavily impregnated two upper layers are removed from the underlying layers. The ointment bearing layers are then cut with sterile scissors into squares just large enough to cover the most prominent part of the lesion. These are laid together with a pair of sterile forceps inside a sterile towel resting on the table. A rectangular piece of rubber dam long and wide enough to hold an adequate hot compress against the lesion is pleated at each end and tied with a piece of umbilical tape or string. The string should be long enough to make a sliding, adjustable loop which passes behind the ears and holds the rubber dam in place without pressure. The infected area is covered with one of the small pieces of gauze spread with the salicylic salve, a large piece of good absorbent cotton is placed on top of and held in place with the rubber dam mask (Fig. 1). The cotton is then kept continuously wet with the hot solution by the patient, using a medicine dropper to moisten the cotton. The cotton and the greased gauze is changed P.R.N. by the patient using the sterile forceps with the aid of a looking glass. As drainage begins, changing and cleansing with soft cotton is required more frequently. When the slough presents, it should not be pulled upon or squeezed until after the tenth day, at which time, if it has not expressed itself, it can be gently teased out. These procedures should be maintained until the evacuation of the slough and subsidence of the greater part of the induration has taken place. The cavity should then be treated with 1 per cent salicylic ointment until epithelized. The horizontal position is permitted as soon as the slough is out. When the multiple openings of a carbuncle demand connection, 95 per cent carbolic on a blunt probe or an electrothermic knife may be used to accomplish this, using great care to avoid injurying any tissues except those surrounded by a protective barrier.

For the small deep so-called "blind boil" of the laity, which occasionally occurs in this region, hot moist compresses are used

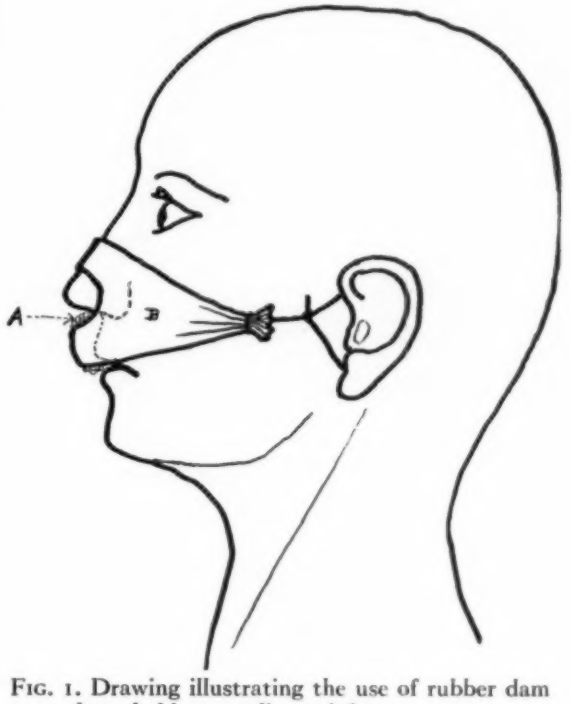

Fig. 1. Drawing illustrating the use of rubber dam mask to hold upper lip and face compresses. A, absorbent cotton and dressings; B, rubber dam mask.

until the slough is completely liquefied. The area is then anesthetized and opened carefully with a sharp Von Graef eye knife, making a small wound. A piece of spear-shaped rubber dam is introduced with plain eye forceps, and salicylic ointment used with hot moist dressings.

The nasal furuncle can be prevented by simple lubrication with boric ointment. If the tenderness is persistent, 1 per cent salicylic acid in boric ointment is soothing and healing. If the process goes on to suppuration, crusts should be removed with hydrogen peroxide as a mechanical cleanser. This is applied on a small cotton wound applicator gently rotated over the surface. When the crust is loosened, it will wipe away on the swab. When the area is carefully cleansed, a 2 per cent salicylic acid in boric ointment is generously applied. This routine is carried out frequently during the day to insure drainage and

comfort. In addition hot moist dressings of absorbent cotton applied frequently will give comfort until the slough is evacuated.

One of the most emphatic "*dont's*" in surgery is *don't squeeze, puncture with a needle or sharp instrument these lesions*, to prevent injurying the protective barrier which has formed around these minute infections.

The painful recurring furuncle of the external auditory canal if treated by frequent cleansing and the application of 2 per cent salicylic ointment, is made more comfortable and the spreading of infection lessened.

Furuncles on women's necks were rarely seen until the bobbed hair style necessitated clipping and shaving the back of the neck. The barber shops modern aseptic technique is a gesture in the right direction, but calls for more adequate sterilization of tools between clients who may be staphylococcus carriers. The period of time edged tools are exposed in the formalin cabinet or that clippers are boiled, is too short for effective sterilization. A barber clips the hair on the neck of one susceptible to staphylococcus infection. The clippers may have been used on the neck of a client recently afflicted with boils and whose skin and hair are contaminated, or perhaps there are a few infected follicles as mentioned, or a tiny infected crust harboring staphylococci. The infected clippers are pressed into the skin of the non-immune, contaminating it; and if they are dull, they pull the hair traumatizing the hair follicle. Infection is further augmented by the hair which has been cut short and thereby stiffened, being pressed into the follicle by the collar, folliculitis develops, and it is a short stage to furuncle or carbuncle. Not infrequently in the less modern shops, there is an added touch of infection when the barber uses the obsolete but germ laden brush to wipe cut hair away from the neck while he drives the infected bristles into open hair follicles and sweat glands. A client's own tools adequately sterilized will prevent primary contamination, but in their absence washing the neck immediately with soap and water, witch hazel or alcohol, will be of service in preventing primary or secondary infection, especially where a razor has passed through an infected follicle.

The attached shirt collar contaminated by secretion from a dressing becomes a real hazard. The neck should be protected against such reinfection until the collar can be removed or replaced by a detachable one. Where much discharge is present, a large dressing held in place by a soft neck bandage covered with a washable hunting stock is desirable. The stock should be changed daily and laundered. Contaminated overcoat collars of either cloth or fur should be washed with 1 per cent formalin solution. Driving in open cars where dust is deposited on the neck and rubbed in by collars require that the neck should be protected by frequently changed and clean mufflers, as well as washing with tincture of green soap.

Women who in recent years have shaved the axilla, used depilatories, and irritating astringent deodorants, are very prone to axillary furunculosis. Here the lesion by reason of the loose subcutaneous tissue burrows and balloons the surface with only moderate pain before an outlet is afforded. The large lymph flow in this region makes for a profuse discharge of watery pus and a gelatinous slough. The quantity of lymph interferes with their healing by forming a boggy granulation over which epithelization progresses slowly. Also the movement of this region interferes with healing and dressings. These lesions are most intractible but yield to simple and meticulous surgical cleanliness and care. To avoid the trauma involved in removing adhesive plaster, a dressing support as shown in the sketch (Fig. 2) is used. Two of these should be made so that they can be laundered frequently. The local dressing is supported by sterile absorbent cotton permitting movement of the arm without local irritation. Disinfection of the contaminated sleeve armholes and dress shields with 1 per

cent formalin solution and the avoidance of any irritating deodorant are essential.

In the male, intertrigo of this and in the perineal and internatal regions is a predisposing factor, and should be treated with mild soothing antiseptic lotions or weak salicylic ointment. Pruritis of the skin about the anus and internatal fold furnish bacteria which are spread to other parts of the body by the finger nails. This together with intertrigo of the perineum and groins should be sought and treated in recurring stubborn cases. A slight discharge from a small anal fistula or pilonidal sinus can furnish a persistent recurring infectious agent.

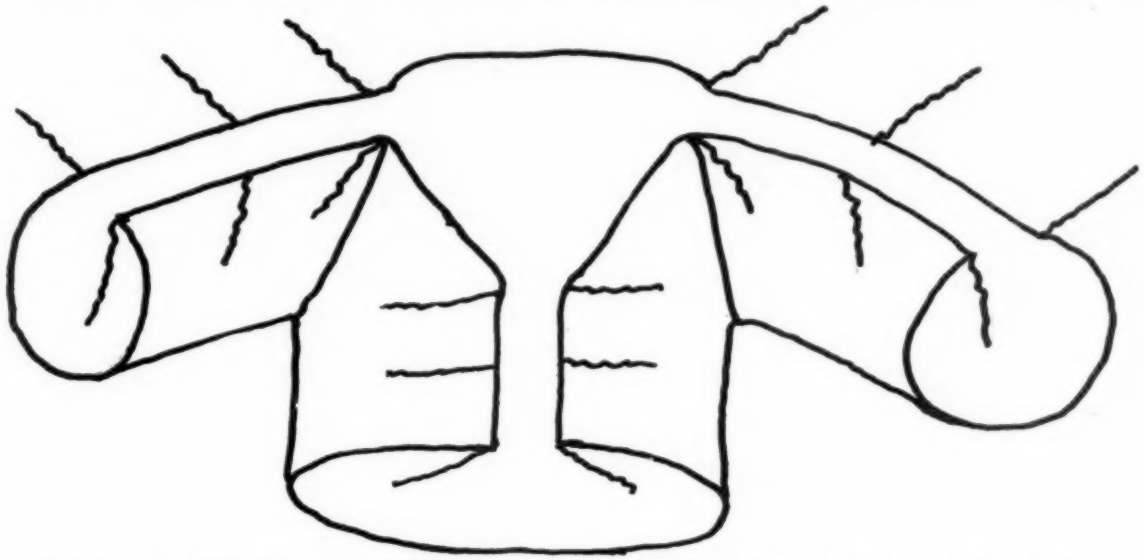

Fig. 2. Drawing illustrating the thin muslin garment with tapes to hold axillary dressings in place.

Doctors and nurses are conspicuously remiss in handling infected dressings with ungloved hands and without instruments. It is imperative for one doing dressings of boils and carbuncles and infected cases, to always use instruments to handle the dressings and sponges, and sterile gloves where possible to avoid contaminating themselves, associates, and patients. It seems absurd to have to mention this, but its justification will likely be apparent to the reader at his next surgical rounds.

Carbuncles are most apt to form in the thick skin of the posterior cervical and upper dorsal region. The infection may spread laterally and involve large areas of tissue, the loss of which will make for prolonged convalescence. They will extend to and involve the deep fascia. In the initial stages one treating these lesions should not overlook the possibility of an infection from anthrax or glanders and proceed accordingly.

A small infection with three or four closely grouped openings can be treated as a boil unless it presents a picture of spreading induration with slight tenderness. Then it should be treated as a carbuncle. In a carbuncle, one should not wait for liquefaction of the slough. The progressive extension by invasion of surrounding tissue outruns localization. Hot moist dressings are used until it is learned where the maximum necrosis has taken place, to determine the type and extent of the incision. As the pressure due to swelling cuts off the local blood supply to a degree which prevents the tissue resisting the spreading infection, early drainage by operation should not be delayed too long, as it affords release of the subcutaneous tension, and prevents extension of infection. The sooner this is done the less destruction of tissue there will be and the shorter the period of convalescence.

In the diabetic, any suppurative process tends to maintain a high blood sugar. This calls for a more complete and immediate

eradication of the suppurative or necrotic lesion than in one who is not. The diabetic should be prepared by his medical advisor, or placed under the control of the medical service in a hospital where his diabetic needs will receive proper dietetic and insulin control. Surgery is merely an adjunct to this, and complete excision should be carried out at the earliest possible moment compatible with his diabetic pathology and preparation.

Operative procedures for other than the smallest lesions should be done in a hospital. It affords an assistant for retraction and exposure to remove necrotic tissue and control bleeding, as well as a surgical nurse and anesthetist.

I prefer general anesthesia to avoid passing needles through infected tissue and local postanesthetic reaction. The prone position necessitated by lesions of the neck and upper back interferes with respiration and calls for skilled anesthesia with resusitation support available.

The incision used should be determined by how much skin can be saved which at the same time will permit complete removal of all necrotic subcutaneous tissue, or a relief of lateral tension by removing a subcutaneous wedge-shaped section from the surrounding infected region. The removal of the wedge leaves an over-hanging margin which supports a blood supply to aid separation of sloughs. I believe this relieves tension better than simple undercutting. The incision can be crucial, H-shaped, or circular. One should attempt to avoid acute angles which tend to slough and produce unsightly scars. The incision can be made with a cutting endothermic knife and bleeders stopped with the coagulating current. When done by sharp dissection, a very small heavy full curved needle carrying a ligature to take a bite of tissue to prevent the ligature slipping, is very helpful to control bleeding. The local tissues are very thick from swelling, and one should go well underneath the necrotic mass to the deep fascia. Removal of a portion of the deep fascia facilitates vascularization and separation of the slough that remains. If all the slough is not removed, it will separate provided incisions have been adequately made to relieve the tension. When major oozing has been stopped by temporary packing, a Mikulicz packing is made with two or three layers of plain gauze wet in sterile saline or boric solution, and with the margins of the incision held open, a small wet packing is used to fill it and the reenterant angles and crevices. The whole is covered with loose moist gauze and a Carrel tube placed in position to maintain constant moisture by irrigation. This is covered with a piece of boiled cellophane and a layer of sterile absorbent cotton to prevent movement of the bandage being transmitted to the tender wound.

The outer dressing is changed in twenty-four hours, and the central packing as soon as it is softened enough by discharge to be removed easily, then it can be replaced with moist loose packing. The layers of gauze in contact with the granulations are left until they lift from the wound surfaces without causing bleeding. The surrounding area is cleansed with alcohol and H_2O_2, and covered freely with 1 per cent salicylic ointment. The adjacent areas are watched daily for induration and tenderness which lasts until the slough is completely separated. If the excision has been complete, there will be little; if incomplete, some sloughing will occur and gradually lessen; but if induration and tenderness progresses further, excision should be done. Boldness at the start will save future trouble. It is surprising how much smaller a wound becomes after the swelling has subsided and all the slough separated. From this point, a simple vaseline gauze packing can be used until the cavity is level with the skin margin. If this packing overlaps the skin edge, epithelization will advance over the marginal granulations as they rise in the wound. The surrounding skin must be kept clean by daily dressings and cleansing. The small isolated furuncles which may develop around the operative area, will be less when 1 per cent salicylic acid ointment has been

used. These are treated with Klotz's emplastrum on adhesive plaster as already described. When the granulations are level with the skin, boric ointment on the granulations covered with flamed adhesive changed every two days, will promote epithelization from the margins and prevent exuberant granulations. Large cavities should be Carreled and skin grafted before granulations have formed an excess of scar tissue beneath them. In hair bearing areas the wound margin should be examined under a bright light with a large magnifying glass, and marginal hairs should be treated with an epilating forceps. Those that are loose and slip out easily should be removed, but unless they come out freely without any discomfort, leave them alone. These loose hairs act as foreign bodies and prevent healing by causing a minute degree of foreign body irritation. Until epithelization is complete without a crust, the wound is not adequately healed.

Before discharge the patient should be instructed how to care for any small follicular infection which might develop, and to use all the prophylactic measures possible. Hydrogen peroxide is not used for its antiseptic value which is nil, but for its mechanical cleansing. I have used a single application of gentian violet and methylene blue 5 per cent solution in 70 per cent alcohol as advised by Kingsley Roberts for skin infection over limited areas with success in conjunction with the above principles where discoloration of clothing and laundry was not a factor. I believe it is an excellent penetrating, non-irritating skin disinfectant with a prolonged action.

Iodine is not mentioned as I never use it in treatment or preparing these lesions for operation. It is an irritant, hardens the surface skin and permits infection to progress beneath it. Soap and water followed by ether is sufficient.

The use of vaccines in the presence of careless surgical cleanliness are of little value and should not be relied upon to do a surgeon's work. However, in conjunction with careful clean surgery they are occasionally an aid in stubborn cases.

I believe that in the future further study of the staphylococcus should bring to the surgeon's aid great help from newer vaccines.

I have made no endeavor to enter the discussion of the newer methods of treatment which have not been sufficiently used to warrant advocating them for general use. A thorough study of existing principles of surgery as related to these lesions together with a due appreciation of their application to the different phases of the changing pathology of boils and carbuncles limited though it is, will afford judgment to evaluate properly any new principles of treatment. I know of no specific.

The material I have given has been used for many years. Four facts I have learned are requisite—drainage, gentleness, cleanliness and thoroughness.

SUMMARY

1. Surgical responsibility regarding these lesions;

2. The relationship of these lesions to the perpetuation and spread of all staphylococcus infection, i.e. carriers;

3. The relationship of staphylococcus carriers to generalized staphylococcus infection;

4. General principles of prevention and care of furuncles and carbuncles;

5. Specific treatment and methods for lesions of face, lip, nose, and axilla; and

6. Treatment of carbuncles are all presented and discussed.

FURUNCLE OF UPPER LIP*

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FOR eighty-five years the peculiarities of an infection of the upper lip have caused special studies to be made and reports to appear in the medical literature, but in spite of a great deal of observation the mortality remains approximately the same. Stromyer's (1855–60) conception that a furuncle on the upper lip was merely the outward manifestation of a pre-existing and underlying infection gave way to Trendelenburg's (1886) thought that such a malignant infection must be due to a specific infection. Failure to show such a specifity, led Trendelenburg later to believe that it was a mixed infection of the mouth. Lenhartz and Lexer (1903) followed with proof that in most instances the causative organism is the common furuncle germ, the staphylococcus. Other organisms may be found and Kocher showed that the streptococcus may be present (Lexer-Bevan 1908). Efforts to find a particularly malignant form of infecting organism shows that our predecessors realized that in this locality an ordinary infection took a different and often fatal course.

Rosenbach of Gottingen (1905) was one of the first to draw attention to the difference in the anatomy of the host in this syndrome, and to clearly understand this entity a brief anatomical review is necessary.

Fascial planes as a rule limit infection and guide its course. In the part of the face we are considering the muscles have no fascia and the skin is closely attached to these muscles of expression. This does two things. It gives no fascial area to limit and collect the infection and it also keeps the skin in this area in constant movement whenever the facial muscles move. This motion constantly pumps septic material into the surrounding tissue spaces thus making the splinting of the infected part difficult. A second anatomical consideration is one of vascular importance. This area is richly supplied with a deep vein plexus which normally drains by way of the facial vein into the internal jugular vein. A tributary of the facial vein, the angular vein, anastomoses with the superior ophthalmic vein at the inner upper angle of the eye, this superior ophthalmic vein being the major tributary of the cavernous sinus. None of these veins have the protective valves present in veins in other parts of the body. A progressive thrombosis of the facial vein diverts the normal venous current to the angular vein and with thrombosis of it and the superior ophthalmic vein a thrombosis of the cavernous sinus is the result (Fig. 1). (A more circuitous course for venous drainage to the cavernous sinus by the pterygoid plexus is less common.) The cavernous sinus is so constructed that it consists of many small compartments, physiologically designed to slow the blood flow and thus prevent too sudden changes in the intracranial pressure due to respiratory influences. This condition lends itself more readily to thrombosis. We have therefore, two very good reasons for the difference in the course of a supposedly mild infection in this portion of the body.

In addition to these anatomical peculiarities in the pathogenesis, one must place the maltreatment of the patient by himself or often by the attending physician who follows an old dictum "Ubi pus, ibi evacua." Many practitioners do not realize that if recovery is to be expected in infections above the mouth area, the axiom "Noli me tangere" must be followed.

The symptoms and course of this condition are best exemplified by a case

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history, the record taken from a distant relative, a senior in law school on the threshold of his professional life. This history amply illustrates the tragic suddenness of disaster from its simple beginning.

Male, aged twenty-one, developed a small pimple on the upper lip near the angle of the right nostril, which was treated by compresses, salves, etc., at home for three days. He was then taken to a nose and throat specialist who applied suction on two occasions. Edema spread rapidly and the eye became swollen and entirely closed. Twenty-four hours later the other eye became closed and a proptosis of the original side appeared. Delirium with high fever showed evidence of the septicemia. He was removed to the hospital where all forms of supportive and restorative treatment failed to arrest the course. Death occurred on the tenth day.

Remarks. This is the usual tragic story of the patient at the beginning of a useful career whose life expectancy of some thirty-five years more is suddenly broken. Earlier and very conservative therapy might have been more efficacious.

Every mistreated pimple on the upper lip will not follow such a serious course. Every day many pimples on the upper lip are squeezed without serious results. It is important to realize, however, that in such instances, a certain percentage will go on to dangerous or fatal complications. It is sufficient if we thus derive a wholesome respect for this lesion and treat each simple pimple as a potentially dangerous adversary, thus preventing the complications.

The treatment necessarily divides itself into the stage of the disease when first observed.

1. *The Pimple.* If the pimple is not disturbed it will invariably subside. This natural subsidence is due to a protective wall of leucocytes built up by nature around the site. Squeezing, rubbing, incising or the application of irritating pastes or solutions disturb this natural barrier and the spread of infection is expedited. Great care in the explanation of the potential danger to the patient is necessary at this time. If the pimple is large, the patient should be kept in bed, talking prevented, and the movement of the lips in deglutition minimized by the use of fluids. General

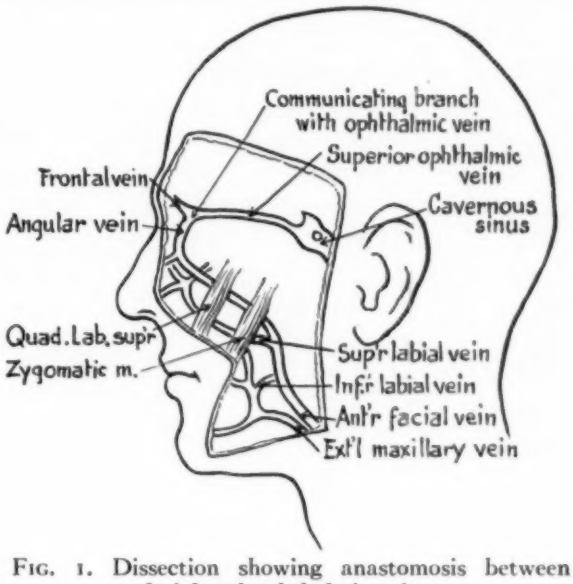

Fig. 1. Dissection showing anastomosis between facial and ophthalmic veins.

body care, maintenance of nutrition and elimination are important measures.

2. *The Furuncle.* The patient is placed in bed at once with careful nursing care. Talking is prohibited and all movement of the lip prevented, utilizing the feeding tube if necessary. General care is maintained including the fluid balance and elimination. Sedatives to control the pain and restlessness are administered as required. Locally, a light cotton pad, kept moistened by a dropper, eliminating the trauma of changing the dressing may be placed over the lesion, the solution used varying with the desires of the attending surgeon provided it is non-irritating. Its effect is only to help keep the surface elimination of the area open and to give some local comfort. An ointment such as 5 to 10 per cent of yellow oxide of mercury may be placed on the area; the ointment by its mild macerating action keeps the small sinuses from congealing. Such a dressing eliminates the weight of the pads.

3. *The Complication Stage.* The development of a spreading infection as evidenced by swelling, redness and tenderness extending up along the nose to the eye and forehead is a grave warning. The treatment as outlined in the furuncle stage

must be continued. Expert nursing care is important. A strictly conservative program as far as the local lesion is concerned is necessary. Nature's effort is to splint and immobilize the area, and any interference with this effort will be followed by disaster. The swelling, the edema, the induration are all a part of this defense, and for the mobilization of every resistive element absolute quiescence of the part is required. The therapy then may be summed up as excellent nursing care, the provision of ample nourishment without the use of the lips, fluids, care as to elimination, sedatives for the pain and restlessness, sponging for hyperpyrexia and delirium, and for the local lesion a splendid surgical restraint. Visitors, consultants who do not fully realize the situation or who disagree with the therapy, and insistent relatives can easily turn the tide fatally at this stage, and success or failure may depend on the artful control of the family and friends. The development of an early confidence in the kin is highly important and sooner or later with continued surgical inactivity this confidence will be tested. The use of blood transfusions in small repeated amounts (250 c.c. every two to three days) is valuable in this stage. This blood, which like all foreign proteins is digested by the recipient, will often provide the extra added defensive element temporarily lacking, and when this defense is destroyed by the patient, it can be replaced. Experience has shown that this occurs approximately every three days. Immunized donors are apparently of help, and the use of bacteriophage as shown by MacNeal has been effective in many instances, especially when combined with blood transfusions.

4. *Cavernous Sinus Thrombosis.* This condition is associated with pyemia and septicemia and the end result is nearly always death. Spontaneous cures have occurred even in this stage and supportive measures and blood transfusions should be continued. Operative therapy on the cavernous sinus is not advocated even though Browder in Brooklyn, and Eagleton both have reported a surgical cure, Browder coagulated the entire cavernous sinus and while the eye was lost, the patient was saved. Other experiences have but hastened the fatal outcome, and have eliminated the occasional cure from general supportive measures and blood transfusions.

The ligation of the angular or facial veins before the spread of the infection has been utilized by many, and in certain instances quite miraculous results have

COLLECTED STATISTICS

Source	Total Cases	Conservative Treatment	Conservative Per Cent Mortality	Operative Treatment	Operative Mortality	Remarks
Bier's clinic	182	182	8.2	..	.....	⅓ upper lip
Dittrich	40	18	5.5	22	13.6	
Breslau	73	36	2.7	37	10.9	Melchinor
Morrison	28	28	0.0	..	.....	Magnesium sulphate paste
Marburg	...	...	....	..	.....	Injected own blood; good results
Lexer clinic (Wrede)	8	8	0.0			
Rodelius	218	218	11.0			
Carp	...	...	....	..	.....	Injected own blood; good results
Crain	...	...	....	..	.....	Magnesium sulphate with good results
Bullock	26	...	....	26	27.07	
Cutler	23	13	21.7	10	50.0	Includes lip, nose, cheek
Martin	7	...	....	7	84.71	Extensive infections

been reported. Theoretically, this plan does not seem a wise one. The placement of a ligature with its necessary operative procedure, violates the conservative plan of therapy outlined which has been found to give a lower mortality than any other course of treatment. Some years ago, a similar plan was used to eliminate the danger of pulmonary thrombosis from thrombophlebitis of the leg. An incision with ligation of the involved vein just proximal to the thrombus resulted fatally in the first 2 instances showing the fallacy of attempting to limit thrombus extension by ligation. There is always some phlebitis and the added irritation from the operation is often sufficient to spread the clot. At the stage that ligation would aid, there is usually a septicemia or a septicopyemia, and previous to this time most will recover with the conservative treatment. One is inclined to believe that the reported cures after ligations were in spite of rather than because of this operation. The frequency of bilateral sinus thrombosis also makes one dubious of such treatment. *X*-ray therapy has been advised for this condition and while it has so far not been established, it may be worthy of trial. The response of some furuncles to roentgenotherapy has been dramatic. Two personal instances failed to respond to this type of treatment. Circuminjections of the patient's own blood as advocated by Bailey, also are not as effective in this area as in the other parts of the body and again violates the "let alone" policy. Mobilization of defensive cells may be better done by whole blood transfusions or immunized donors. Suction, to which the older laryngologists so frequently resort, has directly contributed to the mortality.

In 8 patients recently treated as outlined in this paper there has been no mortality.

SUMMARY

1. Anatomical causes for the severity of furuncles of the upper lip are outlined.

2. The part that maltreatment or overtreatment plays in the pathogenesis is described.

3. A therapeutic outline for the four stages of the disease is arranged.

4. An ultra-conservative treatment is advocated.

REFERENCES

Bailey, Hamilton. Ligature of the angular vein as a preventive measure in facial carbuncle. *Surg. Gynec., Obst.* 46: 565–567, 1928.

Bier. Quoted by Crain, R. C.

Bullock, W. O. Carbuncle of the upper lip with special reference to the prevention of cavernous sinus thrombosis. *Surg. Gynec. and Obst.*, 14: 156–158, 1912.

Case 13242. When not to squeeze a pimple. *Boston Med. and Surg. Jour.*, 196: 1009–1010, 1927.

Coller, Frederick A. Infections of the lip and face. *Surg. Gynec. and Obst.*, 60: 277–290, 1935.

Crain, R. C. Discussion by Jurgens, H. J. The deadly upper lip infection. *Illinois Med. Jour.*, 55: 273–276, 1929.

Curry, G. J. Infections of the lip. *Jour. Mich. State Med. Soc.*, 27: 340–341, 1928.

Cutler, Elliott C. Infections of the lip and face. *Surg. Gynec. and Obst.*, 60: 289–290, 1935.

Foote, Edward M. Local surgical treatment of infections of the face. *Am. Jour. Surg.*, 6: 438–442, 1929.

Hinton, J. W. Danger of infection about face. *Ann. Surg.*, 85: 104–106, 1927.

Hudson, W. L. Staphylococcus infection of face and lips. *Texas State Jour. Med.*, 22: 337–340, 1926.

Jurgens, H. J. The deadly upper lip infection. *Illinois Med. Jour.*, 55: 273–276, 1929.

Kahn, Maurice. Infections of the lip. *J. A. M. A.*, 82: 1043–1044, 1924.

Koslin, Irwin. Primary staphylococcus infection of the nose, lips and face. *Ann. Surg.*, 94: 7–14, 1931.

Lang, O. Lipfurunkel. *Nederl. Tijdschr. v. Genees.*, 64: 2495, 1902.

Lenhartz, Herman. Die Septischen Erkrankungen, 1903, p. 262.

Lanz, O. Furuncle on the lip. *J. A. M. A.*, 76: 348, 1921.

Levin, Oscar. Treatment of furuncles; plea against incision. *Med. Jour. and Rec.*, 131: 253–56, 1930.

Martin, Walton. The fatal outcome of certain cases of staphylococcus infections of the face and lips. *Ann. Surg.*, 76: 13–27, 1922.

Ochsner, E. H. Discussion, Jurgens, H. J. The deadly upper lip infection. *Illinois Med. Jour.*, 55: 273–276, 1929.

Price, John W. Treatment of infections of the face *Ann. Surg.*, 85: 329–332, 1927.

Rodelius. Malignant furuncle of the lip. *Klin., Wchnschr.*, 2: 2348–2353, 1923, Abst.: *J. A. M. A.*. 82: 506, 1924.

Roeder, C. A. Ligation of the angular vein in infections of the upper lip. *J. A. M. A.*, 90: 272, 1928.

Rosenbach. Concerning malignant furuncle of the face. *Arch. f. klin. Chir.*, 77: 715, 1905.

Sheely, C. A. Carbuncle with especial reference to that of the upper lip. *New Orleans Med. and Surg. Jour.*, 80: 807–809, 1928.

Stromyer, Trendelenberg. Quoted by Bullock. *Surg. Gynec. and Obst.*, 14: 156–158, 1912.

Wheeler, W. I. de C. The danger of sepsis about the lips. *Irish Jour. Med. Sc.*, pp. 369–371, 1926.

Wrede. Quoted by Martin.

SALIVARY FISTULA*

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THE salivary glands supplying secretions to the mouth include the follicles of the mouth, the sublingual, the submaxillary and the parotid glands. The latter three are paired glands on either side of the mouth. The sublingual glands secrete a thick mucilaginous secretion, the submaxillary glands a somewhat thinner secretion containing mucin, while the parotid glands secrete a thin watery fluid. All these are mixed to form the saliva, which softens food into a pliable bolus and starts the process of digestion. Ordinarily about 1000 to 1500 c.c. of saliva are secreted by these glands daily.

In considering the embryology of the salivary glands, we may understand their anatomical position and their vulnerability to fistulous formation. The anlage for the submaxillary and the sublingual glands first appear about the sixth week of embryonic life. It is a ridge-like area of the buccal epithelium occupying the furrow marking the angle between the tongue and the floor of the mouth. The sublingual anlage lies nearer the tip of the tongue. The parotid anlage appears about the eighth week and is a development of the oral ectoblast along the lateral groove, separating the upper and lower jaws. At first, the submaxillary and parotid anlages lie about equally removed from the oral opening but migration occurs, the former passing forward and the latter backwards. All these glands begin as a solid cylindrical outgrowth from the deeper layers of the epithelium. The cylinder rapidly lengthens and branches, so that by the eighth to the tenth week, the submaxillary and parotid glands, respectively, consist of a main stalk and terminal buds. The anlage of the sublingual gland gives off epithelial buds and the primary sprouts subdivide, eventually becoming the smaller ducts and the glandular tissue. With the submaxillary anlage moving forward in the buccal development, it becomes closer associated with the sublingual gland and develops a duct (Wharton's duct) of 3 to 4 cm. in length. The ducts of the sublingual glands vary in number from four to twenty or more and are less than a centimeter in length. The largest one (Bartholin's duct) is inconstant and usually opens to the lateral side of the submaxillary duct. Because of the posterior migration, the parotid gland develops the longest duct (Stenson's duct) which is about 5 cm. in length.

From an anatomical standpoint the submaxillary gland comes to lie under cover of the mandible, just anterior to the angle of the jaw, in a fossa on the inner side of the bone. As, however, the skin is carried medially under the jaw at this point the gland appears on the surface. It projects little, if at all, on the outer side of the mandible but curls around the posterior border of the mylohyoid muscle and extends for some distance in the floor of the mouth under the mucous membrane in the angle between the mylohyoid and the hyoglossus muscles. The duct runs from the front of the main body of the gland along the floor of the mouth under the mucous membrane to open into the mouth through a little papilla on either side of the frenulum of the tongue. This gland lies in loose structures of the mouth and is supported by the deep fascia of the neck. At no position is the duct superficial to expose itself to outside injuries.

The sublingual gland, the smallest of the salivary glands, rests against the sublingual

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fossa of the mandible, close to the symphysis and lies on the mylohyoid muscle in the floor of the mouth. Its posterior extremity is in contact with the anterior prolongation of the submaxillary gland. The sublingual gland, which secrets a mucilaginous secretion is favored by opening into the mouth by several short ducts. This gland is not superficial, thus it is not exposed to injuries from the outside. With the sublingual and submaxillary glands lying in the floor of the mouth, there is almost a continuous layer of glandular tissue, part lying in the sublingual region and part lying in the submaxillary region. This area is completely protected by the mandible and at no position are the ducts exposed.

On the other hand with the anlage of the parotid gland moving posteriorly, it comes to lie behind the upper part of the ramus of the mandible, in front of the mastoid process and below the external auditory meatus and the zygomatic arch. It is supported by the deep fascia of the neck which sends septums into the gland, and is most difficult to be dissected from the gland. The gland overlaps the ramus of the mandible, both medially and laterally. The duct of the parotid gland is formed by two chief tributaries and emerges from the front of the gland, above its middle, running forward and a little downward across the masseter muscle to turn sharply at its anterior border. It then crosses a mass of fat and runs obliquely through the buccinator muscle and mucous membrane to empty into the mouth opposite the second upper molar tooth. A portion of the gland and duct become superficial over a bony surface, thus favoring injuries from the outside to cause fistulous developments. If the gland or duct should be injured, it practically always affixes itself to the skin margin, developing a fistula.

For practical consideration all salivary fistulas develop because of a break in the continuity of the gland or the duct, whether due to injury or obstruction in the duct and rupture of the proximal portion. Obstruction may arise from concretions or infection. A salivary fistula from the gland proper which is usually a small lobule lends itself to local treatment and will usually heal spontaneously. If developed from the duct, where we have a continuous flow of saliva, it is difficult to treat and rarely heals without surgical intervention. Most of the salivary fistulas are derived from the parotid gland and its duct. These have been found in the external auditory meatus from a misplaced portion of the gland, also as a complication in surgery of the mastoid region and with injuries over the area of the parotid fossa or the ramus of the mandible. Similar to other tubes of the body, as the biliary or the urinary ducts, the ducts of the salivary glands develop lithiasis, causing obstruction of saliva, followed with rupture of the viscus or infection and ulceration, thus producing a fistula. The parotid duct, because of its location, is most vulnerable to injury and is the most difficult to respond to treatment.

A salivary fistula is usually a very small opening on the skin. There is a constant wetting of the area from the flow of saliva, which is increased by the stimuli to the gland, whether chemical, mechanical, electrical, thermal or psychical. The fistula may be probed, but only when connected with the duct will a probe be admitted for any distance. To determine whether dealing with a true salivary fistula or a branchial fistula, it is better to collect the secretion and apply the chemical test. Mucin, a constant product of saliva, is a glyco protein, insoluble in water or dilute acid but soluble in dilute alkali and can be precipitated from the saliva by dilute acid or alcohol, or by saturating with ammonium sulphate. It gives the usual protein color reactions but is not coagulated by heat in neutral solution. We may apply the digestive action of saliva to carbohydrates. The opalescence of a starch solution will gradually disappear if saliva is added. Also starch gives a blue color with iodine. As digestion progresses, the dextrins are formed, which give a reddish color with iodine.

In the treatment of salivary fistulas the operations designed are to transplant the sinus tract in order to have the drainage into the mouth. It is only when the ducts are injured that such plastic operations may be performed. De Guise has an operation in which a piece of silk is threaded through two needles and the needles are carried through the cheek into the mouth. The silk surrounds the fistulous tract and when tied within the mouth brings the proximal portion of the tract closer to the mucous membrane. It is better to incise the mucous membrane, so that it is more likely that the fistula will empty into the mouth. The skin portion of the tract is freshened and sutured. If it is possible to transplant the fistulous tract within the mouth by plastic operation, it is the surest procedure. Dilatation of the tract may follow.

If the fistula arises from the gland proper, there may be one or more sinuses. In such a case it is better to treat the gland locally with phenol or cautery, endeavoring to exterminate that area of the gland. An escharotic agent of undoubted value in the treatment of glandular fistulas in contrast to duct fistulas is Cutler's solution. This is to be reapplied using pressure and allowing the tract to close gradually. When saliva forms beneath the skin, local pressure over the area sometimes will prevent the further development of a fistula. At the time of an injury of a salivary duct great care should be taken to approximate the edges. The duct should be sutured, but not allowing the suture to pass into the lumen of the duct, and pressure should be applied. Remember always to make sure that the distal portion of the duct is open. This is done by passing probes from the oral opening. If the duct is injured close to the gland, it may be necessary to tie the duct proximally, and in this manner allow atrophy of the gland. Atrophy only will take place if no infection is present. Favorable results have been recorded by the use of *x*-ray therapy or the division of the auriculotemporal nerve in order to diminish the secretion from the gland. With the use of *x*-ray irradiation Meyers feels that it is better to use an accumulative dose of *x*-rays until the secretion is stopped, rather than a massive dose. If any operation in the region of the parotid gland, such as excision of neoplasms, hemangiomas, abscess or parotid tumors, is contemplated, it is a safe move to pass a filiform through Stenson's duct in order to identify this structure. In obstruction of the duct the structure will roll easily under the finger where it passes over the ramus of the mandible.

The treatment of sublingual fistulas is clinically unimportant as the fistulous orifice always opens into the mouth and never on the skin.

With submaxillary fistulas it is better to excise the gland as plastic operations are unsuccessful and are usually followed by stricture and calcareous formations. The gland lends itself to surgery because of no septums passing in to the gland from the supporting fascia and it lies in loose tissue which is easily dissected.

SUMMARY

1. The majority of salivary fistulas arise from the parotid gland and its duct, usually the result of lacerations, whether surgical or traumatic.

2. Diagnosis of salivary fistulas is established by a study of the secretions from the fistulous tract.

3. Salivary fistulas of the gland are treated with local cauterization with external pressure; of the duct, by an attempt at transplanting the fistulous opening into the mouth or elimination of the gland completely.

REFERENCES

Schrieber. *Ann. Otol., Rbinol. and Laryngol.*, 26: 1917.
Blair and Padgett. *Arch. Surg.*, 7: (July) 1923.
Smith and Torgerson. *Surg., Gynec. and Obst.*, 41: 318–319 (Sept.) 1925.
Tees. *Can. Med. Assn. Jour.* 16: 145–146 (Feb.) 1926.
Simpson. *South. Med. Jour.*, 22: 215–216 (March) 1929.
Abercrombie. *Jour. Laryngol. and Otol.*, 45: 474–476, (July) 1930.
Portman. *Ann. Surg.*, 101: 1175–1180 (May) 1935.
DaCosta. Modern Surgery.
Meyers. Personal communication.

ACUTE PYOGENIC PAROTIDITIS*

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ACUTE pyogenic parotiditis is the subject of a voluminous and controversial literature. It is, nevertheless, of especial interest to the general surgical and medical practitioner because of its occurrence as a postoperative complication and a concomitant of various debilitating illnesses.

Suffice it to say, by way of historical comment, that the condition has received the attention of physicians since the time of Hippocrates, who refers to it in the "First Book of the Prorrhetika." Pliny, Galen, and Celsus refer to it in their writings, and Paulus Aeginet described at some length a method of treatment. Since that time, down through the moderns, beginning with Virchow in 1858, there have been almost countless contributions to the literature, a further review of which would be superfluous, as excellent analyses will be found in the papers of Jennings, Rankin and Palmer, Custer, Blair and Padgett, Talbot and others.

ANATOMY AND PHYSIOLOGY

The parotid is a compound racemose gland, lying on the posterior half of the masseter muscle, below the ear, and behind the angle of the jaw. Posteriorly, it is in contact with the external auditory canal; this is of great significance, as abscesses sometimes point at this site. The gland discharges its secretion into the mouth through Stenson's duct, which arises from the upper anterior portion of the gland, about 1 cm. below the zygoma, and runs in an imaginary line connecting the tragus and the center of the upper lip. Its opening is on an easily visualized papilla opposite the second upper molar, and on gently everting the cheek may be catheterized. Operative trauma to the duct is more likely to result in a fistula than is injury to the gland itself.

The gland is enclosed in the dense parotid fascia, which is an extension of the cervical fascia, and is continuous with the masseteric fascia and the deep fascia of the neck. There may consequently be an extension of the infection into the deep planes of the neck, and downward over the anterior chest wall, involvement of the breast having been noted.

Depending upon the location within the gland, the pus, if unrelieved in tension, may perforate into the external auditory canal, or into the temporomaxillary joint. It may also work its way between the pterygoid muscles, around the carotid artery and open into the pharynx. It may erode through the carotid artery or jugular vein, or break through the encapsulating fascia and burrow down the neck.

Because of the denseness of the overlying fascia, or in the case of a deeply situated abscess, it is often difficult to determine the presence of fluctuation, and, hence, the tendency is sometimes to delay drainage too long after suppuration has actually occurred.

The blood supply of the gland is received via numerous twigs from the superficial temporal artery. The external carotid, after entering the gland, divides into the temporal and internal maxillary arteries, the former giving off, in the substance of the gland, the transverse facial artery, which runs forward between the zygoma and the parotid duct. Also within the gland, the temporal vein unites with the internal maxillary vein, which, after receiving the

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posterior auricular vein, empties into the external jugular. The facial nerve, after emerging from the stylomastoid foramen and entering the substance of the gland, gives off numerous filaments; a large trunk usually accompanies Stenson's duct, running just below it.

This gland is peculiar, in that it often contains one or more well defined lymph nodes. The lymphatic drainage is into both the superficial and the deep chains of cervical lymph glands.

Many drugs, such as atropine, morphine, and many analgesics, cause a diminution of salivary flow and should be avoided from a point of view of prophylaxis. Drugs, such as iodine, bromine, mercury, lead, quinine, and several others, are partially excreted through the salivary glands, and may possibly be a factor in lowering the resistance of the gland to infection. During the induction stage of anesthesia, salivation is copious, but then diminishes, and is not reestablished until many hours after the patient has reacted.

These physiological facts are of especial significance in relationship to pathogenesis, prophylaxis and treatment.

PATHOGENESIS AND BACTERIOLOGY

Probably the most discussed question throughout the literature has been that of etiology. All the discussions delineate themselves into one of five lines of thought:

1. Parenchymatous degeneration of the gland due to the heat of pyrexia;
2. Degeneration of the gland due to the toxins of the primary disease;
3. Degeneration produced sympathetically following operations on the generative organs;
4. Infection of the gland by organisms derived from the blood stream;
5. Infection of the gland by ascension of bacteria from the mouth through Stenson's duct.

For practical purposes, the two latter modes are the only ones which merit consideration. Infection via the lymphatics can, of course, occur, but presupposes a source of infection within the lymphatic radius of the gland, and such is not frequently demonstrated. Direct trauma, and infection following obstruction of the duct, are obvious and need not be considered here.

While it would be quite illogical to assume that all infection must occur by one or the other route, the majority of modern opinion favors the ductogenous route as the one followed in the majority of cases, and while there is no reason why hematogenous infection should not occur, it is difficult to adduce indisputable evidence, clinically and bacteriologically, that such be the case.

The basic work along these lines was done by Rost in 1914, who concluded that the pathologic picture was the same whether the gland became infected via the duct or the blood stream. In 1931, Berndt, Buck and Buxton, in attempting to corroborate the preceding work, found marked differences in the pathologic picture produced, so that from a given microscopic picture, the mode of infection could be predicated.

Bacteriologically, the most common infecting organism is the staphylococcus, usually aureus, although the streptococcus and pneumococcus are not rare. The Bacillus typhosus has been isolated in pure culture in cases of typhoid fever, but this is not necessarily significant because the organisms are present in many of the parenchymatous organs during the disease. In general, the failure to correlate the organism isolated from the gland with that from the primary infection, constitutes *prima facie* evidence that the condition is not metastatic. It is also noteworthy that the organisms usually infecting the gland are those which exist normally in an avirulent state in the mouth and lower part of Stenson's duct. In addition, most cases show evidence of infection of the duct, pus being present at the orifice.

Furthermore, there are numerous factors which favor the ascent of infection. In debilitation and acute infections, there occurs a lowering of the general body

resistance, and, therefore, a relative increase in the virulence of the normal buccal bacterial flora. Diminution of salivary secretion and flow occurs in fever, dehydration, vomiting, and restriction of fluids, and is an important predisposing factor. Pawlow has shown that reflex cessation of salivary flow accompanies laparotomy and visceral manipulation. As has been noted, salivation ceases for some hours following general anesthesia, in addition to which mechanical pressure on the gland by the anesthetist or apparatus may occur, thereby tending to lower the resistance to infection.

Certain facts which support the hematogenous theory, however, must be taken into account. Parotiditis can be produced by the injection of organisms into the nutrient artery. The parotid is usually alone involved, the submaxillary and sublingual glands being unaffected, and it may be argued that this hypothecates a predilection of the gland for organisms circulating in the blood stream. Fisher maintains that the majority of cases are hematogenous in origin.

Rankin well epitomizes the situation when he says: " . . . facts were not discovered which would substantiate a single type of cause in all (cases)."

PATHOLOGY

The pathology is the same as that of an acute inflammatory process leading to suppuration in any other similar type of tissue. Grossly, there may be many small isolated abscesses throughout the substance of the gland, but more frequently the entire gland is brawny and indurated. Gangrene of the entire gland has been noted. Microscopically, it is seen that the parenchyma of the gland is involved, rather than its supporting structure. In ductogenous inflammations, the ducts are distended with exudate, the larger radicals showing the principal involvement, with destruction of the lining epithelium. Certain areas will show where the infection has broken through the duct wall, causing small multiple abscesses containing chiefly polymorphonuclear leucocytes. There is little or no change in or about the blood vessels.

In hematogenous infections, the ducts are less involved, with more involvement of the small radicals than in ductogenous infections. The arterioles show swelling and hyperplasia of the lining endothelium, with occasional thrombus formation. The reaction around the ducts is more of a mononuclear than a polynuclear one.

OCCURRENCE

Acute pyogenic parotiditis is usually thought of as a postoperative complication, but it occurs with almost equal frequency in non-surgical conditions, although it is no longer very common. Of all cases treated at the New York Post-Graduate Hospital during the past sixteen years, we were able to find only 30 cases of acute parotiditis.

The condition may occur during any period of life, but in several series of cases which have been reported, it has been found to occur most frequently in the third decade. More cases are seen in women than in men, but this probably is due to the fact that morbidity is higher in females than in males. There is also an apparent seasonal trend which parallels the incidence of upper respiratory infection, the greatest number of cases occurring from November to April, inclusive. A few of the cases apparently occur as a primary disease, or secondary to an acute nasopharyngitis or the extraction of a tooth. Four of our 30 cases had suffered no previous illness.

Many of the older observers were impressed with the frequency with which parotiditis occurred following pelvic operations, particularly those on the gonads, and attempted to account for this phenomenon by postulating an intrinsic relationship between the gonads and the parotid gland, following the analogy of the frequent involvement of the gonads following mumps.

The affection has followed almost every type of surgical procedure, but apparently it occurs more often after pelvic operations and those carried out in infected fields. In

his article on postoperative parotiditis, Rankin comments on the fact that in a large series of cases, the complication occurred 17 times as frequently following operations on the colon as in a series of general surgical cases.

Of non-surgical conditions, the literature contains countless reports of the condition occurring as a complication of typhoid fever, pneumonia, typhus fever, scarlet fever, diphtheria, measles, cholera, dysentery, malaria, plague, influenza, erysipelas, puerperal sepsis, infectious arthritis, tuberculosis, tularemia, and dengue fever. It may also complicate any of the chronic debilitating diseases, such as the blood dyscrasias, cardiac disease, cirrhosis of the liver, kidney disease, and diabetes.

Both sides are involved about equally, and between 22 and 33 per cent of the cases are bilateral.

This is well summarized by Blair and Padgett, who list the primary conditions upon which this complication most frequently supervenes, as follows:

1. As part of a postoperative complex;
2. Following an infected wound in any part of the body;
3. In the course of any acute infectious disease, most particularly typhoid fever and pneumonia;
4. In any severe asthenic state;
5. As a terminal condition.

PROPHYLAXIS

Prophylaxis is of exceeding importance and is predicated upon the facts and principles already alluded to. The points upon which especial emphasis should be placed are:

1. Scrupulous maintenance of oral hygiene through adequate dental care prior to operation and during the period of morbidity, together with the frequent use of antiseptic mouth washes;
2. Maintenance of a free flow of saliva, by avoiding, in so far as is possible, those drugs already mentioned which decrease salivary secretion. The administration of as much fluid by mouth as is compatible with the nature of the case, and the use of chewing gum or some other common sialagogue;
3. Maintenance of the general well being of the patient and the avoidance of extreme cachexia by transfusion or other means, with special attention to the maintenance of an adequate positive water, chemical, and caloric balance. The avoidance of untidy or dirty surroundings, and the prevention of sordes and decubitus ulcers, in addition to provision for meticulous nursing care in general.

SIGNS AND SYMPTOMS

The onset of acute parotiditis is usually sudden and quite striking, so that one is immediately aware of a change in the existing clinical syndrome. In cases, however, in which the virulence of the infecting organism is low, the onset may be insidious with gradual swelling of the gland, slight elevation of temperature, and little pain.

As a rule, there is a sudden rise of temperature to as high as 105 degrees F., accompanied by swelling in the parotid area, and extreme pain over the gland, usually to such a degree that motion of the lower jaw is difficult or impossible. With the onset, the patient becomes rapidly more toxic in appearance, and will attempt to avoid all movement involving the head, jaw, or neck.

The gland is usually hard and indurated and its borders are not difficult to define. In most cases, the opening of Stenson's duct is swollen, reddened, and pouting, and droplets of purulent saliva or frank pus will exude from it. If the vital reserve of the patient has not been unduly depleted by the primary disease, a high leucocytosis will be found.

With the extension of the infectious process, a spreading edema occurs, causing the eye on the affected side to swell shut, and it may extend downward over the neck as far as the clavicle. It may also extend inward to the pharynx and involve the glottis, resulting in asphyxia. Delirium

may occur, and in children convulsions are quite likely to supervene in the course of a severe infection.

The location of the preliminary or primary pain may vary according to the location of the process within the gland. Swelling of that portion of the gland lying in the glenoid cavity immediately in front of the external auditory canal, will cause pain in the ear, simulating otitis media, especially in children, and in the temporo-maxillary articulation. Swelling of those portions of the gland lying on the internal pterygoid muscle, and between the external carotid artery, causes severe pain and fulness in the throat, simulating a nasopharyngeal affection. When the lower jaw is opened, the space posterior to it in which the gland lies, is diminished, thereby pinching the gland against the bony meatus and mastoid process, so that it is impossible to open the mouth widely.

Gangrene of the gland, when it occurs, is fatal. On theoretical grounds, involvement of the seventh nerve should frequently occur, but, clinically, at least, it is almost never seen.

TREATMENT

Treatment demands surgical judgment. The question of paramount importance, of course, is when to incise and drain the gland. The answer is sometimes difficult to give, owing to the fact that the physical sign of fluctuation is difficult to elicit, and, hence, it is hard to tell when suppuration has actually occurred. There are many who feel that incision and drainage should be done at the earliest possible moment, but, on the other hand, both Rankin and Fisher have pointed out the effectiveness of early expectant and conservative treatment. Both recommend the deferring of operation until the clinical picture, as evidenced by increasing temperature and leucocytosis, shows that subsidence is not taking place, and makes surgical intervention imperative. Under these circumstances, the process may often have sufficiently localized itself so that a minor surgical procedure will accomplish more than a radical one would have in the instance of early interference.

There are many cases, however, which undergo complete subsidence under conservative measures; these are the cases of low virulence, those occurring in patients not seriously debilitated by other disease, and most of the primary or "idiopathic" cases. The measures most commonly employed in such instances consist of the forcing of large quantities of fluid by mouth, or if this is not possible, parenterally; the application of cold to the gland during the initial stage, followed later by hot applications to hasten localization; the use of antiseptic mouth washes; chewing gum where its use is not too painful or impossible; and frequent catheterization of Stenson's duct by means of graded whalebone filiform dilators until the orifice of the duct will admit a blunt 22 or 20 gauge needle.

Probably the greatest contribution to the treatment of acute infections of the parotid gland was made by Rankin and Palmer in 1930. They observed that by using radium, and particularly by its immediate application to the gland on the first appearance of swelling, that they were able to materially reduce the incidence of suppuration and thereby the morbidity and mortality. A large dose is not necessarily more effectual than a medium sized one; the main necessity is early application. The maximum dose found necessary was four applications, eight hours in duration, at intervals of eight hours, of four 50-milligram tubes of radium. The filtration used was 2 mm. of lead, 1 mm. of brass, and 0.5 mm. of silver; the distance was 2.5 cm., and the total milligram hours 6605. The minimal dose was two applications, eight hours in duration, at intervals of eight hours, of 50 milligram tubes of radium, with filtration as stated. The total milligram hours were 800.

Under this regimen, for the first twenty-four to forty-eight hours, there is either no change in symptoms, or a slight exacerba-

tion. At the end of this time, a rapid subsidence begins, and in the less severe cases, the patient is well recovered by the fifth or sixth day. With this form of treatment, surgical intervention rarely becomes necessary, and the mortality is vastly reduced. Taking all factors into consideration, this is probably the treatment of choice where its use is available.

For those cases which demand surgical drainage, a number of incisions have been recommended. All have their advantages and disadvantages, the main points to remember being adequate exposure, and the avoidance of injury to important structures.

The incision recommended by Fisher is "Y" shaped, the stem being made along the vertical ramus of the jaw, and the limbs extending anteriorly towards the zygoma, and posteriorly towards the mastoid process. This gives good exposure and is anatomically safe.

The incision used by Blair and Padgett is one which starts 2 cm. in front of the ear, at the lower border of the zygoma, running back to the ear, and then downward to behind and below the angle of the jaw. Along this line the facial nerve lies deeply and is further protected by making multiple punctures into the gland with a blunt curved hemostat, making certain that no lobes of the gland are overlooked. The wound is packed open with iodoform or plain gauze and a pressure bandage applied. Relief of symptoms is almost immediate. Fistula rarely results following this operation. For general use, this method probably gives the safest and best exposure, and the most satisfactory end-results.

It is sometimes possible to determine the presence of a definite, small, circumscribed area in which the localized tenderness is of maximum degree. In such cases a small incision may be made over this area with the introduction of sharp Kelly forceps, the glandular tissues spread apart, and a small rubber tissue drain inserted. This is known as Hilton's procedure and will often obviate extensive surgery.

Regardless of the method of specific therapy chosen, it is essential that supportive therapy be carried out to a maximum degree, with especial attention to the water and chemical balance of the patient, and maintenance by the various means available of an adequate caloric intake. This is of the utmost significance in regard to prognosis, as it is our feeling that the mortality in these cases is not due to the parotiditis *per se*, which is really, in most instances, a secondary manifestation, but to the original disease.

PROGNOSIS

The death rate as reported by various authors, varies from 33 per cent in those cases requiring incision, to 42.8 per cent for all cases in the series reported by Blair and Padgett. In the 30 cases studied at the New York Post-Graduate Hospital, there were 8 deaths, or a mortality of 26.6 per cent. All these deaths occurred in cases in which the prognosis at best was extremely hazardous, and only one of the cases of parotiditis was primary.

In Rankin's series of cases treated with radium, the mortality was 5 per cent, which is significant when compared with other figures. Many clinicians feel that the parotiditis itself can only rarely be considered as the cause of death. In most cases the affection is merely a concomitant complication, and the original disease, or some significant factor, must be regarded as the lethal agent.

SUMMARY

1. Acute pyogenic parotiditis is of medical and surgical importance.

2. The preponderance of evidence seems to indicate that the majority of infections are ductogenous, rather than hematogenous in origin.

3. The histopathologic pictures produced in the two instances are dissimilar and sufficiently characteristic to predicate the mode of infection in a given instance.

4. The majority of cases are caused by the Staphylococcus aureus; Staphylococcus albus, the various streptococcic strains, pneumococcus, and Bacillus typhosus occur, but with far less frequency.

5. The affection has its highest incidence in females during the third decade, and during the months of November to April, inclusive. It follows many medical, as well as surgical conditions.

6. Prophylaxis rests on scrupulous oral hygiene, a free flow of saliva, and maintenance of general bodily economy.

7. The most characteristic clinical signs are pain and swelling in the parotid region, pyrexia, and leucocytosis.

8. Treatment consists of supportive and conservative measures, with recourse to surgery in the event that these prove futile. If radium is available, and its use can be controlled by one who is competent to do so, it will probably afford the most effective means of treatment.

9. The affection in the majority of cases is not of itself lethal; death should usually be attributed to the original disease, or to some other complication.

REFERENCES

Antupit, L. Postoperative parotitis in abdominal surgery. *Tr. Sect. Obst., Gynec. and Abd. Surg.*, 49: 53, 1927.

Berndt, A. L., Buck, R. and Buxton, R. von L. The pathogenesis of acute suppurative parotitis. *Am. Jour. Med. Sc.*, 182: 639–649, 1931.

Blair, V. P. and Padgett, E. C. Pyogenic infection of the parotid glands and ducts. *Arch. Surg.*, 7: 1–36, 1923.

Charlton, P. H. Postoperative parotitis. *Ann. Surg.*, 93: 837–843, 1931.

Collins, C. U. Parotitis as a postoperative complication. *Surg. Gynec. and Obst.*, 28: 404–407, 1919.

Combs, C. N. Postoperative suppurative parotitis. *Anestb. and Analg.*, 7: 92–94, 1928.

Custer, R. P. Acute suppurative parotitis. *Am. Jour. Med. Sc.*, 82: 649–661, 1931.

Deaver, J. B. Postoperative parotitis. *Ann. Surg.*, 69: 128–130, 1919.

Elterich, T. O. Purulent parotitis in the newborn. *Jour. Ped.*, 3: 761–764, 1933.

Fisher, W. H. Treatment of postoperative suppurative parotiditis. *Ann. Surg.*, 86: 445–448, 1927; Postoperative infective parotitis. *Ann. Surg.*, 77: 568–571, 1923.

Hobbs, W. H., Sneierson H. and Faust, L. F. Acute and chronic infections of the parotid gland. *Surg. Gynec. and Obst.*, 54: 555–563, 1932.

Hobbs, W. H. and Sneierson, H. Infections of the parotid gland. *Am. Jour. Surg.*, 32: 258–271, 1936.

Jankelson, I. R. Septic parotitis in gastric hemorrhage. *Med. Jour. and Rec.*, 135: 517–518, 1932.

Jennings, F. D. Postoperative salivary gland infections. *Am. Jour. Surg.*, 8: 1201–1203, 1930.

Layman, D. W. Pyogenic infection of the parotid gland. *Jour. Ind. State Med. Assn.*, 24: 465–472, 1931.

Lilienthal, H. A method of incision of the parotid abscess without injury to the facial nerve. *Am. Jour. Surg.*, 31: 101–102, 1917.

Muller, G. P. Davis' Applied Anatomy. Ed. 8. Phila., J. B. Lippincott Co., 1929.

Novak, E. and Antupit, L. A. Postoperative parotitis. *Med. Jour. and Rec.*, 122: 249–251, 1925.

Peightal, T. C. Postoperative parotitis with a report of cases. *Am. Jour. Obst. and Gynec.*, 11: 88–95, 1926.

Rankin, F. W. and Palmer, B. M. Postoperative parotiditis: treatment without and with radium. *Ann. Surg.*, 92: 1007–1013, 1930.

Talbot, H. S. Acute suppurative parotitis. *Am. Jour. Surg.*, 25: 267–276, 1934.

WENS

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THE lowly though frequently conspicuous "wen," or sebaceous cyst, has received scant consideration in the American literature for what are presumably obvious reasons. As humble as Uriah Heep, it can nevertheless often be as irritating as that famous character, and an effort further to expose it is therefore, we hope, justified.

In order perhaps, to get a clearer understanding of sebaceous cysts, it would be well to recall briefly the structures comprising the skin itself. First we have the epidermis with its corneal, granular and prickle layers, and directly beneath this the corium, derma or true skin composed of a thick layer of fibrous and elastic tissue and merging below with the fatty subcutaneous tissue with its blood vessels, nerve fibers, special nerve endings and lymphatics. Finally, we have the appendages of the skin consisting of the hair, nails, sweat glands and sebaceous glands. These various structures are well seen in Figure 1, a unique photomicrograph of the scalp, unique in the fact that it was taken not from normal scalp, but from scalp tissue found within a dermoid cyst of the ovary.

The sebaceous glands themselves, about as numerous as the sweat glands, arise in the corium, beginning at about the sixth month of embryonic life as lateral off-shoots from the rudimentary hair bulbs. As they gradually develop, small, fat granules appear in the central cells, sacculations form, and the gland becomes branched or lobulated. A basal layer of cuboidal cells develops which is continuous with the basal layer of the epidermis and the hair follicle and these in turn give rise to larger central cuboidal cells which develop fatty changes. These cells as they increase in size and number finally rupture and discharge their fatty contents into the lumen of the gland, new cells from the active proliferating basal layer being supplied to take their place. The sebaceous or oil glands are thus seen to be usually, though not always, closely associated with a hair follicle into which their ducts as a rule empty. There may be as many as two to five glands emptying into each follicle, but some of the glands, especially about the nipples, genitals and lips, open directly on the surface of the skin independently of the hair follicle, and still others usually of a large size, open on the surface of the skin in conjunction with the lanugo hairs, the downy hairs occurring on the forehead, ears and trunk.

The sebaceous glands then, occur in the corium on all parts of the body except the palms, soles and terminal phalanges. They are lined by epithelium continuous with that of a hair follicle or the epidermis itself, and through their ducts discharge their fatty contents either for the most part into the hair follicles, or directly on to the surface of the skin.

If the duct becomes obstructed from dirt from without, from inspissated contents or as the result of inflammation, a cyst will form from the gradual accumulation of the odorous glandular contents within the gland itself and the distention of its walls, for a sebaceous cyst is of course, a retention cyst.

A cyst formed in this way by an accumulation of contents within the body of the gland itself is what really should be known as a sebaceous cyst. Broders however, believes, as Angrist has also pointed out, that many times cysts form within the duct rather than the body of the gland and that such cysts, often regarded as sebaceous cysts, are in reality epidermoids or kera-

tomas. In contradistinction to true sebaceous cysts, the keratomas contain a non-fatty material, odorless, unless infection is present, made up of layer upon layer of keratin originating from the epithelium lining the duct of the gland.

Sebaceous cysts, usually small, though sometimes as much as 2 inches in diameter, may occur anywhere on the surface of the body where sebaceous glands exist. As a matter of fact however, they are rare below the waist line though occasionally occur in the skin of the scrotum. They are commonest about the scalp and face, behind the ear, in the eyebrow or in the skin from which the beard grows. Often single, but especially in the scalp or scrotum frequently multiple, they occur also on the neck, shoulders and back. They are most frequently seen in individuals who have reached middle age.

They are usually painless, rounded or globular masses, not lobulated, pinkish in color, somewhat firm and elastic, though sometimes soft or even doughy, movable with the skin over the deeper structures but always attached at one point to the skin itself. This of course, is at the site of the opening of the duct into the hair follicle or on the surface of the skin and on close inspection at this point, may often be seen as a black speck which is the occluded or obstructed duct. Because of this point of attachment, the skin, especially with small cysts, cannot be moved over them, a fact which helps to differentiate sebaceous cysts from others, such as dermoids, which are of different origin. The cysts first grow within the skin itself, but as they increase in size, spread out into the underlying areolar tissue so that in large cysts the skin may be movable upon them at all points except at the central point of attachment.

As the cysts grow, the epithelial lining by a multiplication of its cells is likewise increased. These cells, gradually cast off in a state of fatty degeneration, together with fatty granules and cholesterin crystals, go to make up the contents of the cyst, in the smaller ones somewhat semi-solid or pasty in consistency, but in the larger ones usually more fluid, the capsule meantime becoming more or less fibrous. They grow rapidly at times but often have a dormant period

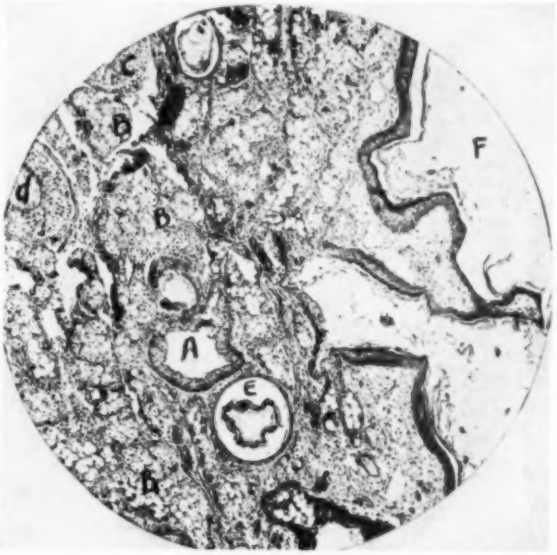

Fig. 1. Scalp tissue taken from wall of a dermoid cyst of the ovary; A, duct of sebaceous gland; B, sebaceous gland; C, hair follicle; D, hair shaft; E, cyst of duct, epidermoid, with keratin layer; F, free border of the scalp surface toward cavity.

when they do not seem to grow at all, later again increasing in size. As they gradually enlarge, the overlying hair, noticeable in the scalp, becomes thinned out by pressure until it may completely disappear, and the skin itself may become irritated and inflamed or may even ulcerate as a malignant ulcer. The cysts themselves, especially those behind the ear or on the face, frequently become inflamed and often suppurate, discharging their contents externally, only as the inflammation subsides, to fill up again unless completely removed.

With the presence of such a cyst, with a history of slow growth and with perhaps periods of inflammation or suppuration, the diagnosis of sebaceous cyst is usually a simple matter. Confusion may nevertheless exist as to whether we are dealing with an ordinary wen, or perhaps with a dermoid or other growth.

Dermoids, however, are congenital and therefore may become apparent in childhood as well as in adult life, whereas wens are rare in childhood and usually occur in

middle age. Dermoids moreover, usually occur at points of fusion, and are therefore found chiefly about the inner or outer protuberance. Dermoids also are usually covered by normal, freely movable skin and are not attached to the skin at one point,

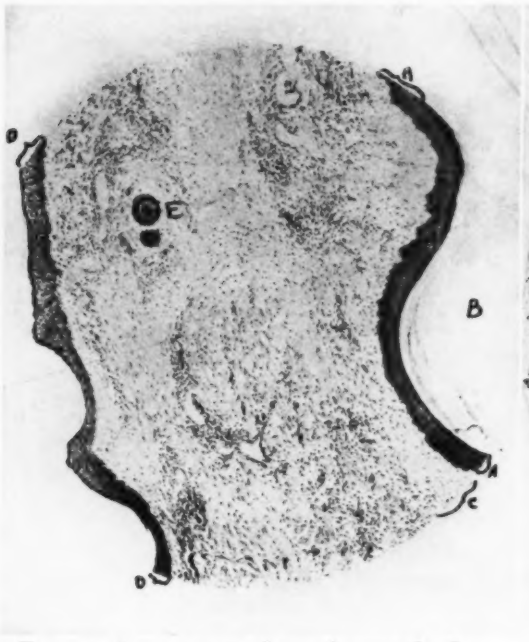

Fig. 2A. Low power photomicrograph of an epidermoid cyst with keratinizing squamous epithelial lining. A, epithelial lining (compare with Fig. 3A); B, cavity; C, connective tissue wall; D, overlying skin; E, hair follicle.

Fig. 2B. High power photomicrograph of epidermoid cyst; A, keratinizing epithelial lining (contrast with Fig. 3B); B, keratin content; C, connective tissue wall; D, stratum granulosum.

Fig. 3A. Low power photomicrograph of lining of sebaceous cyst; A, epithelial lining; B, sebaceous content; C, connective tissue wall; D, calcification.

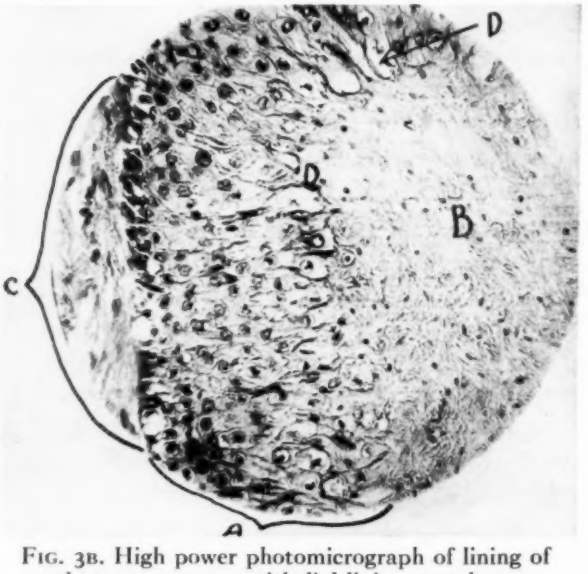

Fig. 3B. High power photomicrograph of lining of sebaceous cyst; A, epithelial lining; B, sebaceous content; C, connective tissue wall; D, large vacuolated cells resembling foam cells of sebaceous glands.

angles of the orbit, in the upper eyelid, or in front of or behind the ear, in the region of the anterior fontanelle or the occipital as are the sebaceous cysts. Dermoids, however, are invariably attached at their base to the deep fascia or periosteum or to the

perichondrium of the ear and hence are not freely movable over the underlying structures and cannot slide over them as wens do. The sacs of dermoids become thicker at the base and if they contain hairs or other structures characteristic of dermoids, the diagnosis is apparent. Their contents moreover, are free from the rancid odor so peculiar to the sebaceous cysts.

Lipomas are usually distinctly lobular; sebaceous adenomas are rare and are usually a solid mass with a very thin covering of skin. So called "cirsoid aneurysms," consisting of tortuous, dilated, pulsating vessels, are characterized by the usual complaint of "rushing noises" in the head and by their resemblance on palpation to a "bag of worms." Plexiform neuromas, usually affecting branches of the trigeminal nerve, are diffuse, soft masses in which separate cords can be readily palpated.

Sebaceous cysts especially when they ulcerate, frequently resemble epitheliomas, and in fact, this subject should not be dismissed without calling attention to the possibility of malignancy developing within the cyst itself, especially if ulceration is present. These epitheliomas, usually of the squamous cell type but occasionally made up of prickle cells and less frequently of basal cells, grow into the cyst from the inner aspect of the wall itself and do not early invade the surrounding tissues. Ricker and Schwalbe reviewed the literature up to 1914 and found 43 cases of sebaceous cysts in which carcinoma had developed in the cyst walls. In 17 of these ulceration was present. In a more recent report among 236 cases at the Mayo Clinic, Caylor found 12, or 3.4 per cent, in which malignancy occurred, ulceration being present in 4 patients. Bishop of the Steiner Cancer Clinic in Atlanta, in a series of 119 cases, found

Fig. 4. Sebaceous cyst of a scalp in a woman sixty years of age; duration for forty-five years.

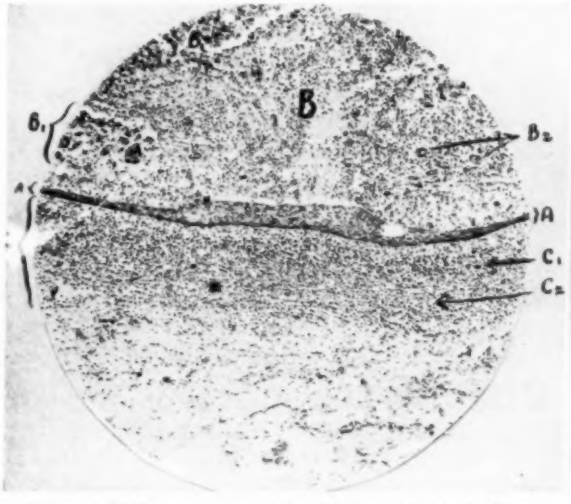

Fig. 5. Sebaceous cyst altered by chronic inflammation with granulation tissue organization of contents and wall; A, epithelial lining; B, organizing contents with B_1, group of foreign body giant cells; B_2, vascularization; C, connection tissue wall with C_1, foreign body giant cells and C_2, other inflammatory cells.

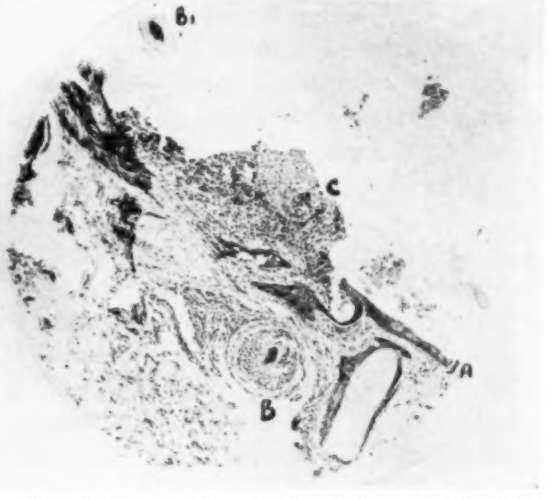

Fig. 6. Dermoid cyst of eyelid; A, epithelial lining; B, hair follicle; B_1 hair shaft; C, organizing tissue with giant cells.

malignancy in 9.2 per cent. Stone and Abbey of the New York Post-Graduate Medical School and Hospital, reported in 1935 an incidence of malignancy of 2.2 per cent in a series of 363 cases of sebaceous cyst studied. Malignancy was seen most frequently in cysts on the face and scalp, usually in patients over sixty years of age and about as often in one sex as in the other.

If a sebaceous cyst is completely removed, it does not of course, return and even if malignancy occurs and is recognized before the adjacent tissues are involved, recurrence is rare after wide and complete excision, for metastasis is infrequent.

Sebaceous cysts therefore, should be removed, not only because of the possibility of malignancy, but also because of their unsightly appearance and their susceptibility to inflammation and suppuration. A local anesthetic may be injected diamond-fashion about its base and if necessary beneath the cyst, or if the wall is not too thin it may be infiltrated between it and the surrounding skin forming a plane of cleavage and thus facilitating the enucleation. A straight incision may then be made directly over the cyst, or if the cyst is large and the skin redundant, an elliptical incision is made leaving the skin in the center attached to the cyst. Care, however, must be taken not to perforate the cyst as the enucleation is simpler if this accident can be avoided. With fine, curved scissors the skin edges are then separated exposing the cyst wall itself. With an elevator used for the submucous resection of the nasal septum, the sac can usually be readily enucleated, after which with the application of a little pressure to control oozing and the insertion of the necessary interrupted sutures or clips, a dry dressing is applied. If the sac is accidentally opened, this does not mean infection of the wound, unless suppuration already exists, but care must be taken under such circumstances to remove the entire cyst or recurrence will take place. If suppuration is actively present, it is wiser to incise and drain and not until the infection has later subsided, to remove the sac.

If malignancy is present or suspected, wide excision through normal tissue is, of course, essential. No attempt should be made to shell out the cyst and any incision into the growth during its removal should be unerringly avoided. Finally, every sebaceous cyst, innocent as it may appear, should be subjected to competent examination, microscopic if necessary, and if malignant changes are found, its removal should be followed by irradiation.

SUMMARY

1. The normal histology of the sebaceous glands and of other structures of the skin is first discussed.

2. The development of sebaceous cysts with their usual clinical manifestations is described.

3. The differential diagnosis between sebaceous cysts, keratomas or epidermoids, dermoids and other growths is discussed.

4. The possibility of malignant degeneration occurring in sebaceous cysts is stressed.

5. The treatment for sebaceous cysts is outlined.

In connection with the preparation of this paper, I wish to express my appreciation for the excellent work done by Mr. J. F. Rendich of the Department of Photography, for the ready assistance of Dr. Wm. J. Hoffman, Director of the Tumor Clinic, and for the ever to be relied upon cooperative spirit of Dr. Angrist, Pathologist, all of the Queens General Hospital, Jamaica, New York.

REFERENCES

Buxton. *Jour. Cutan. and Genito-Urin. Dis.*, 1901.
Christopher. Textbook of Surgery. Phila., W. B. Saunders & Co.
Clarke. *Ann. Surg.*, 1904.
Eller. The Practitioner's Library of Medicine and Surgery, Vol. x, 1936. New York, D. Appleton-Century Co.
Green. *Arch. Ophth.*, 2: 145–151, 1922.
Havens. *Surg. Clin. N. Am.*, 15: 1227–1232, 1935.
Kleinschmidt. *Deutsch. med. Wchnschr.*, 57: 1931.
Stone and Abbey. *Arch. Dermat. and Syph.*, 31: 512–515, 1935.
Sutton and Sutton. Diseases of the Skin. Ed. 9. St. Louis, C. V. Mosby.
Van Beuren. *J. A. M. A.*, 66: 111, 1916.
Waring. *Virginia Med. Month.*, 59: 607–608, 1933.
Wigglesworth. *Boston Med. and Surg. Jour.*, 7244 and and B.P. 698 (March) 1875.

MOLES, WARTS AND KELOIDS*

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MOLES

MOLES are classified in dermatology as pigmented nevi. They are accumulations of pigment in the skin with or without other skin changes, and are of congenital origin, but may not be visible at birth. They vary in color from a pale yellow or light brown to a bluish black, and may be single or multiple, varying in size and shape. They occur on any part of the skin surface and there is probably no adult who hasn't at least one mole of some kind.

There are several theories as to the origin of moles and at present the consensus of opinion is they are of epithelial origin. The melanoblasts or melanin forming cells produce pigment. They are in the basal layer of the epidermis but in a mole they migrate into the corium. Here they may still produce melanin, although the mole itself, after a period of growth, usually remains quiescent and becomes fibrotic. A mole presents a rather characteristic histopathlogy in that it contains groups of "nevus cells" in the corium with increased pigment in the basal layer. The nevus cell is a large, round or oval cell with large, vesicular-like, deeply staining nucleus. It may or may not contain pigment. Malignancy in a mole is carcinoma and not sarcoma. The exception to this is malignant development of the so-called "blue nevus" which is of mesodermal origin and becomes a nevosarcoma. The blue nevus is not included among the moles as it is really a mongolian spot that has persisted in an unusual location.

The subject of moles has for years been overlooked and little understood by the general physician and surgeon. Now that we have been made so cancer-conscious, the tendency has been to the other extreme and moles have become the cause of a good deal of controversy. In the minds of many, both physicians and laity, every mole is a dangerous lesion and should not be treated, destroyed or excised unless absolutely necessary because of the possibility of malignant development. Dermatologists, as a group, know this opinion to be most extreme and it is their duty to correct this widespread confusion. Had the dermatologist, rather than the surgeon, been more active in this phase of the cancer program from its inception, the idea of all moles being precancerous lesions might not have become so prevalent. It is important that the medical profession generally should get together on this subject and be of one mind as far as possible. The dermatologist advises the patient his mole may be removed without the slighest danger, only to have the patient say his family physician or some other specialist has emphatically told him never to have it touched. This causes a lack of confidence which is sure to hinder the progress and success of any program.

It is agreed that some moles have an element of potential malignancy, but it may also be stated that the common mole, especially if it has hair, rarely becomes malignant even when irritated. This is borne out by the experience of many outstanding dermatologists, who for years have been removing moles of various kinds

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and have not seen one become malignant. The general pathologist may, on rare occasions, see malignancy in a "mole," without having examined the original lesion or knowing just what type it was to begin with, and get to believe all moles are dangerous. It is the black, blue-black or slate-colored mole, which is smooth and shiny and has no hair, the so-called melanotic mole that is dangerous and becomes the highly malignant melanocarcinoma. This is the type that has probably caused the confusion and controversy.

That brings us to the question should moles in general be removed; which moles must be treated; and which should be left alone? Specific treatment will be elaborated later when the various type of moles are discussed. As was stated, it is absolutely safe to remove any ordinary pigmented mole, especially if it contains hair. However, as a rule, they should only be removed either for a cosmetic reason or because they happen to be located where they may be constantly irritated, as in a man's bearded region, etc. It is always important in these benign lesions to keep in mind that the therapeutic end-result should be an improvement cosmetically over the original lesion. Some moles, especially in places exposed to trauma or irritation, may show signs of increasing growth and/or pigmentation. These should be removed. Increased vascularity and bleeding or ulceration are always a danger signal and should be considered valid reason for treatment. However, that does not usually mean radical surgical excision with intensive *x*-ray or radium therapy. As irritation may cause malignant development, it surely is sensible and good preventive medicine to remove these growths while they are benign, especially if they are disfiguring. The black, blue-black or slate-colored mole is always a serious problem. If it is quiescent and not being irritated or liable to be traumatized, it is best left alone and watched. Should it show signs of activity, the combined opinion of a dermatologist and a surgeon should, if possible, be obtained and the lesion widely and deeply removed. Naturally one always wonders whether it might not be better to excise these potentially very malignant moles when they are quiescent and not wait until they do become active. This would surely be better cancer prevention, although some say it is wiser to "let a sleeping dog alone."

For the consideration of specific therapy, moles may be classified into many types, depending on their individual characteristics and variations. The following is an arbitrary clinical classification adopted for the purpose of this paper:

1. Pigmented macules (nevus spilus);
2. Fibromatous "white" mole (probably fibroma);
3. Hairy mole (nevus pilosus);
4. Black and blue-black mole (melanoma);
5. Warty mole (nevus verrucosus).

TREATMENT

There is no uniform method of treatment for moles as each type presents an individual therapeutic problem and one should use the method that in his experience will give the most thorough removal with the best cosmetic result. The particular method will thus vary with individual men. I shall give the procedure in the various types that has given me the best results. The modalities used are electrodesiccation and electrocoagulation, electrocautery, electrolysis, solid carbon dioxide, caustics such as trichloracetic acid, and surgery, either with the electrical cutting current or scalpel. I always favor the method, if possible, that does not require many repeated treatments. *X*-rays and radium are mentioned only to be condemned as they must be given in erythema doses to be of any value, and surely benign lesions should not be subjected to erythema doses of irradiation, with their possible sequels.

1. *Pigmented Macules.* These flat, nonhairy spots or patches vary in color from a pale, yellowish brown to a dark brown and may be single or multiple. They need only

be treated for cosmetic reasons when they are unsightly. They are absolutely inoccuous. The small areas can easily be removed by electrodesiccation under local procaine anesthesia. A very mild cold spark is used and the desiccation is very superficial. The desiccated area is then removed with a dull skin curette and the base mildly desiccated, leaving a superficial, dry crust. If, in a week or two, after the crust falls off, there is still some pigment left, the procedure may be carefully repeated where it is necessary. In large patches the area may have to be treated in divided portions. Solid carbon dioxide may be used in the large patches but it cannot be as easily controlled and requires several repeated treatments. Trichloracetic acid (U.S.P.) should be mentioned in the treatment of the smaller spots. The acid is applied with a moist cotton applicator, being careful that it is not running wet and does not get on normal skin. To make sure, vaseline may be applied around the pigmented area. As soon as the area ,turns white, it is neutralized with tap water by applying dripping wet pledgets of cotton. A scab is formed and falls off in about ten days. This may have to be repeated and if one is careful almost no scarring is obtained.

2. *Fibromatous Moles.* These are very slightly or not at all pigmented, and usually do not contain hair. Microscopically they are really fibromas, and it is a question whether they should be included in the classification of moles. They are most common on the face, but on the back, in the axilla and groins, they are usually pedunculated. Electrodesiccation or cautery under procaine is the method of choice, being careful not to go too deeply. It is always better to do too little rather than too much, thereby preventing a depressed, pitted scar. After the lesion is desiccated, it is cut down almost to the level of the skin with a fine pair of scissors. Then the base is again mildly desiccated. If after the crust falls off the lesion is still raised above the level of the skin, it is again very superficially desiccated. If it has hairs in it, these may first be removed by electrolysis, and this at times causes disappearance of the mole.

The procedure with electrocautery is similar to desiccation. A flat electrode is used and the mole is seared down to the level of the skin, being careful not to do too much. Some men favor electrolysis, using the negative electrode and a current of 2 to 3 ma. The growth is transfixed in several directions parallel to the skin. After the crust falls off the treatment is repeated and in this way the lesion is "shaved" down flat to the skin. However, the method is inferior to desiccation because it requires more treatments, takes a longer time and is surely more irritating.

These growths may be removed by scalpel but it is not necessary and the cosmetic results are not as good. With the scalpel you get a linear scar, larger than the original lesion; the scar may be wide and may become keloidal. As for the pedunculated type, they are easily removed by grasping the lesion with a forceps and snipping it off at the base with a small, sharp scissors, being careful not to include normal skin, and then superficially and mildly desiccating the base. This is best done under local procaine anesthesia.

3. *Hairy Moles.* These vary in color from a very light to a dark, almost blackish brown. They are usually small in size and occur most often on the face. However, they may be present on any part of the skin and at times are so extensive as to involve large portions of the body. This is seen in the so-called "bathing-trunk" type of hairy nevus. In the small growths, it is always best to first remove the hairs by electrolysis. This at times may also cause a disappearance of the mole. If there is still some of the lesion left, it is removed by desiccation or electrolysis. However, when there are very many hairs in a small sized mole, especially if it is very dark brown in color, I do not attempt to remove the hairs by electrolysis because of the irritation and the danger of scarring. Here it is best to desiccate the lesion as if there were no hairs in it, using the same method that was de-

scribed in the removal of the fibromatous "white" mole. Later when the mole itself is gone, the hairs may be removed by electrolysis. In the larger sized hairy moles solid carbon dioxide is the treatment of choice, and if one has the patience, using repeated small doses over a period of many months, a very nice result can be obtained without too much scarring. If they are not too large, they may be removed by plastic surgery. This method when successful is surely much faster but it is a problem for the surgeon to decide in the individual case. When one thinks of the many dark brown, hairy moles that have been treated by solid carbon dioxide, with its repeated irritation over a period of many months, without causing carcinomatous changes, it is readily seen that moles have a very low potentiality for malignancy.

4. *Black and Blue-black Moles.* Although the term melanoma is given to all kinds of pigmented moles, it seems best to reserve this name for the blue-black or slaty colored mole. This is the highly dangerous type and is always a serious therapeutic problem. It is smooth, has no hair and is usually more or less raised above the skin. Most dermatologists are of the opinion they should be left alone when there are no signs of activity and they are in locations not exposed to trauma or irritation. However, they have such a dangerous potentiality for malignancy and are so deadly when cancer does develop, it might be better to remove them when they are inactive if they are situated where they may be easily irritated. Never treat this type with any irritating form of therapy. *X*-rays and radium have been used, but as nevus cells are highly radioresistant it requires massive doses which may lead to undesirable sequels. If the lesion is inactive and one decides to leave it alone, the patient should be watched and should be cautioned to immediately report any signs of activity. When the lesion is active and surgery is indicated and decided upon, the excision must and should be very wide and very deep down to fat, in a cone shaped manner, the lesion itself being the apex. Some use the high frequency cutting current instead of the scalpel because of its supposedly lessened danger of metastasis. However, better and quicker healing is obtained following scalpel surgery. If microscopic examination shows melanocarcinoma, intensive doses of filtered *x*-rays or radium should be immediately given. Some radiotherapeutists advise this be done preceding excision and it might be just as well to do so.

5. *Warty Moles.* This type may occur anywhere on the skin surface. They are usually dark brown in color, warty in appearance and as a general rule do not contain hair. In size they vary greatly and may be so extensive as to cover a large portion of the body. In some instances, they are arranged in unilateral streaks and bands and are called linear nevi (nevus unius lateralis). The warty moles are best removed by electrodesiccation or coagulation under local anesthesia. Following coagulation, the area is thoroughly curetted. After bleeding is stopped with pressure, the base is mildly desiccated leaving a dry crust. This may be covered by a bland ointment such as boric acid and the dressing changed daily. The wound heals in a few weeks usually with little scarring. Very extensive areas may require several operations for entire removal. However, if possible and the resultant wound not too large, it is best to do it all at once. Excision by scalpel is very seldom necessary.

In the group of verrucous nevi, the so-called nevoid keratoses are often included. Although clinically they simulate seborrheic keratoses, they differ from these lesions in that they occur in much younger individuals, there is no accompanying seborrhea and they are often familial. They are small, dark in color, slightly raised and often numerous. If for cosmetic reasons the patient wishes them removed, it is best done by electrodesiccation followed by curettage. Several individual lesions may be removed at a sitting. The cosmetic result is usually excellent.

WARTS

Warts or verrucae are benign epidermal new growths formed by hypertrophy of the papillae. They are probably infectious and are thought to be caused by a filterable virus. They are auto-inoculable and can be transferred from one person to another by inoculation.

They are divided into four clinical varieties:

1. Verruca vulgaris, the familiar common wart;
2. Verruca plana juvenilis, the flat "juvenile" wart;
3. Verruca plantaris, the plantar wart;
4. Verruca acuminata, the "venereal" wart.

1. *Verruca Vulgaris.* There are several types of the common wart, such as the digitate and filiform wart, and their names describe them very well. The so-called seborrheic and senile warts are not placed among the verruca. They are classified as keratoses, have a different histopathology and are precancerous lesions. The ordinary common wart is seen usually in children and most frequently on the hands and fingers. However, the different types may occur at all ages and any place on the skin or mucous membrane. There may be one or several in number and at times be very numerous. The filiform variety is usually seen on the neck and eyelids; the digitate type on the scalp and face.

In discussing the treatment of warts, it may be best to preface any remarks by saying they may disappear spontaneously, may easily respond to any kind of treatment, or be so recalcitrant as to almost defy any method of therapy. The fact that warts do disappear spontaneously gave rise to psychotherapy or "suggestion" treatment, and several dermatologists have had a marked degree of success with this method. The patient is made to believe some treatment is really being used. The lesions themselves are painted with any colored liquid, and may even be given a placebo treatment with some electrical modality, whatever it may be. The advocates of this method stress the value of impressing the patient that the warts are sure to disappear. In certain instances, when simple methods fail, or because surgical procedures cannot be used, psychotherapy should be kept in mind. At times slight trauma of any kind will cause a wart to disappear, so that one may give the mildest kind of treatment and get a good result. As for prognosis, no matter how stubborn warts may be, with persistence and therapeutic ingenuity they can always be cured.

The various methods of treatment for warts in general are electrodesiccation, cautery, electrolysis, curettage, solid carbon dioxide, caustics, *x*-rays and radium. There are also internal remedies such as protiodide of mercury, bismuth salicylate in oil, and sulpharsphenamine. I prefer desiccation, when possible, or irradiation, depending on the age of the patient, the location and number of warts. If there are one or a few lesions, and the patient will allow local procaine anesthesia, electrodesiccation is the surest and quickest way to get rid of them. There is always the possibility of scarring, but if it is not overdone usually gives an excellent cosmetic result. Using a very mild current, the needle is inserted into the wart several times, being careful not to go too deeply. The dehydrated wart is then lifted up and cut away at its base with a sharp pointed scissors, making sure the "core" is removed. The rough edges are trimmed and the bleeding is stopped by gauze pressure. The base is then very mildly and superficially desiccated, leaving a dry scab. This is dressed with boric acid ointment or vaseline, and falls off in a week or so. If there are many warts, several may be done at a time until all are removed. Even with thorough removal, warts do recur, and it is best to warn patients or their parents of this possibility.

X-rays and radium give a high percentage of cures in warts, and because of the absence of pain and the ease of application, many patients prefer taking the chance and

trying it. Unfiltered *x*-rays or the beta rays of radium are used. Depending on the size and depth of the wart, three-fourths to two skin units (erythema doses) are given, shielding the lesion very closely. If there are many warts, irradiation is difficult because of the time element, but it can be done on successive days, treating several each day. Care must be taken not to overlap if the warts are close together. Depending on the dose, the treatment may be repeated in a month or longer, if there is an improvement. *X*-rays or radium are particularly of value for warts occurring at the side and under the nails, because they are so difficult to remove surgically. Should there happen to be many warts closely aggregated in one area, as digitate warts in the bearded regions, unfiltered *x*-rays in fractional doses may be tried, and at times are successful. It is in these cases that recurrences are common following electrodesiccation. Here the internal remedies may also be used, either in conjunction with the *x*-rays or alone. Of these I prefer insoluble bismuth salicylate in oil, 0.03 to 0.12 gm., given intramuscularly once a week for as long as twelve weeks. Sulpharsphenamine, 0.2 to 0.4 gm. in 2 c.c. of water, intramuscularly, has given excellent results in some cases, but it is a dangerous drug, is quite painful, and for warts the much less dangerous bismuth is to be favored. In the line of psychotherapy, sterile distilled water, 1 c.c., has also been used intramuscularly with almost as good results as bismuth or sulpharsphenamine. The other forms of therapy as electrolysis, solid carbon dioxide, caustics, etc., are easily applied but are painful, require repeated treatment and usually do not remove the wart.

2. *Verruca Plana Juvenilis.* These small, flat, skin colored or light yellow lesions occur chiefly on the face or backs of the hands. They are smooth and very slightly raised but not warty to the touch. Although usually seen in children they do occur in adults, and are generally multiple in number. Protiodide of mercury pills, 1/8 to 1/4 grain three times a day, should always be tried for several weeks as they seem to be effective at times. Bismuth salicylate and sulpharsphenamine have also been used with success. Along with these internal remedies, lotio alba in various strengths, or ammoniated mercury ointment 3 to 5 per cent, is used locally. Very often unfiltered, fractional doses of *x*-rays, giving 1/4 of a unit once a week, are successful. When these methods fail or when the patient, usually an adult, wishes results as quickly as possible, electrodesiccation followed by curettage is the method of choice. Each lesion, without anesthesia, is mildly desiccated and then gently scraped off with a sharp skin curette. If done carefully, with a weak current, no scarring results, but recurrences are apt to follow. It is possible recurrences are due to the fact that some hardly discernible lesions are overlooked and it is therefore of value following desiccation to use lotio alba or preferably ammoniated mercury locally.

3. *Verruca Plantaris.* These warts occur on any part of the plantar surface of the foot and toes, but most frequently on the sole. They are single or multiple, and may be on one or both feet. At times they are quite painful. It is not difficult to differentiate them from calluses, which do not have a central core. The chiropodists and podiatrists call them "papilloma." Their method is to pare the lesion down and use various caustics; it is painful, requires several treatments and is seldom successful. The treatment of choice for plantar warts is irradiation or electrodesiccation. Unfiltered *x*-rays or the beta rays of radium are used, and are given in doses of one to two and one-half units, depending on the size of the wart and the age of the patient. Each wart is pared down with a sharp razor blade, before treatment, and very closely shielded. If there is an improvement, treatment may be repeated in a month or so depending on the dose. Quite often, shortly after *x*-ray treatment, the pain is alleviated. Should irradiation fail,

electrodesiccation is usually successful, although even careful, thorough removal may be followed by recurrences. The most difficult part of the procedure is the procaine anesthesia, especially in young children. When there are several or many warts in children a general anesthetic may have to be given. The plantar surface of the foot is very sensitive and one should try to procainize the area with one prick of the needle, using sufficient procaine to produce complete anesthesia. The desiccating needle is then inserted into the area several times, and the entire lesion is dehydrated. The wart is then lifted up and cut away with a sharp scissors, down to the fascia. The base is curetted and the edges of the wound are trimmed. After bleeding is stopped the entire area is mildly desiccated. The wound is dressed with borated vaseline and protected by a "bunion plaster" with a hole slightly larger than the area. The patient is told to favor the foot and not actually step on the wound, but should not be inconvenienced otherwise or be obliged to stay home. Infection rarely occurs and healing takes place in several weeks.

The internal remedies, such as bismuth, sulpharsphenamine and protiodide of mercury are less efficacious than in other warts. A simple method, which at times is successful, is paring the lesion and covering it with strong salicylic acid plasters. It takes a long time however, and if the wart is painful the patient wishes relief as quickly as possible. In fact, when a plantar wart is very tender I prefer electrodesiccation to *x*-rays because the wound is much less painful than the wart and the relief is immediate.

4. *Verruca Acuminata.* These "venereal" or "moist" warts occur on the mucous and mucocutaneous surfaces of the genitalia, genitocrural and anal regions. They are usually seen in adults, are multiple in number and often coalesce to form large, conglomerate, vegetating masses. In diagnosis they must not be confused with the flat, moist papules of syphilis or condylomata lata. When they are not too numerous each lesion may be desiccated and curetted, which requires time and patience, and it may be necessary to use a general anesthetic. The large, conglomerate masses are removed by electrocoagulation and curettage, under local or general anesthesia. Following the operation, the area is kept clean with antiseptic solutions, such as weak potassium permanganate, and covered with borated vaseline. Recurrences should be watched for and immediately treated. If the patient does not wish operative procedures, *x*-rays should be used although I have had very little success with them in this variety of wart. The unfiltered rays are given either in weekly fractional doses or semi-intensive doses every two or three weeks. Meanwhile the area is treated locally with antiseptic wet dressings and dusting powders. The internal remedies have been of little value in the treatment of acuminate warts but they may be tried if necessary.

KELOIDS

Keloids are overgrowths of the fibrous connective tissue of the skin, developing at the site of an injury or scar. They differ from hypertrophic scars, which are also overgrowths of fibrous tissue and keloidal in appearance, but do not extend beyond the original line or area of injury as do keloids. Whereas keloids are always due to some inherent idiosyncrasy or tendency in certain people, hypertrophic scars may be due to tension on a wound. The surgeon and his method of surgery or skill cannot be blamed for the occurrence of a keloid. It has been noted that some people who have had a marked idiosyncrasy to keloid formation may in later years lose this tendency.

Two varieties of keloids are spoken of, the spontaneous or idiopathic form, and the one that arises in any ordinary scar. Most dermatologists do not accept the theory of spontaneous origin of a keloid. This type usually follows some slight, inconspicuous trauma of which the patient was not aware. In a person with an inherent tendency to keloid formation, squeezing a pimple, a

mosquito bite or any mild injury may result in a keloid. The colored skin is particularly inclined to keloid formation. They may be single or multiple, occur on any part of the skin and may be quite extensive. At times, especially following burns, there is a good deal of contraction with resultant deformity and disfigurement.

The treatment for keloid is irradiation or surgery combined with *x*-rays or radium. Any surgical procedure alone is fairly certain to result in another keloid, usually worse than the original growth. However, in patients who seem to have lost their tendency to keloid formation, surgery may be attempted. Some surgeons have devised special operations for keloids that are at times very successful. For young keloids, *x*-rays are the treatment of choice. The lesion is shielded closely and suberythema doses of unfiltered rays are given once a month. If the scar is very large, it can be treated in divided areas being careful not to overlap. In keloids that are quite raised, it is best to use filtered *x*-rays, also giving suberythema doses. When the scar is old and very thick, it requires many *x*-ray treatments for as long as a year or more and even then may not be successful. In these cases the combination of surgery and *x*-ray irradiation saves many months of treatment and usually gives excellent results. This is due to the fact that *x*-rays have a selective action on fibroblasts and young connective tissue cells but old fibrous tissue is radioresistant. Under local anesthesia the keloid is either excised with scalpel or the electric cutting current. If the scalpel is used and the wound is small it is closed with as few sutures as possible or with skin clips. However, I prefer using the electric cutting current and leaving the wound open. In about three to five days, the area is given three-fourths of an erythema dose of unfiltered *x*-rays. This is repeated in three weeks and if there is the slightest sign of keloid formation following the second treatment, it is again repeated. If the wound is quite extensive, skin grafting may have to be done followed by *x*-rays. Large keloids may have to be removed in divided areas. If it is done at one time and the wound is too large to treat with *x*-rays at one exposure, the area must be carefully mapped out so as not to overlap. I do not feel it is of any value to give *x*-rays before or immediately following excision because they do not prevent keloid formation. With the combination of surgery and *x*-rays the resultant scar is usually flat, smooth and thin, and the cosmetic effect is very satisfactory.

SUMMARY

Moles, as a group, have a very slight tendency to malignant development. The black or blue-black mole is potentially very malignant and is a serious therapeutic problem.

The types of moles are described with the various methods of treatment for each type. It is perfectly safe to treat the ordinary mole.

The varieties of warts are described with the methods of treatment.

The treatment of keloids is discussed. As a rule they should not be excised. Treatment is either with *x*-rays or radium, or a combination of surgery and irradiation.

BENIGN TUMORS OF BACK*

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THE back is the site of numerous benign tumors, many of which are also found elsewhere on the body. To classify these tumors which are peculiar to the body must necessarily conflict with tumors in general. As space is limited only a few of the more important of these will be considered, with their appropriate treatment.

LIPOMAS

These are the most common connective tissue tumors and may arise from connective tissue as well as from adipose tissue. The "embryonic rest" theory gives a reasonable explanation of many lipomas starting in tissue which normally contains no fat.

Lipomas usually contain a fibrous capsule and are divided into lobules by fibrous septa. There are however diffuse forms which do not seem to have a definite capsule. The capsule and septum are very thin and delicate but following infection or irritation they may become greatly thickened. There has been no malignant form reported but they are true tumors for they are not reduced in size during the course of a general wasting disease.

Lipomas usually occur in most any part of the body in which there is adipose tissue. They are most frequently seen however in the subcutaneous fatty tissue of the shoulder and lower part of the back, and usually occur singly although they may be multiple. These tumors tend to become pediculated on the back where traction is exerted by their weight. They grow slowly as a rule but may vary from a stationary condition to a very active process. Sometimes they develop to an enormous size weighing as much as sixty to seventy pounds. As a class they are probably the largest solid tumors. Ulcerations followed by infection, gangrene and calcarous degeneration frequently occur.

Because of deformity, ulceration and pain, surgical removal is always indicated. In the pediculated one it is quite essential to excise the entire base of the pedicle. In the nonpediculated type of moderate size, well encapsulated, an adequate way of excision consists in cutting completely through the tumor mass in the center of its greatest diameter. In the depth of the wound the two halves of the tumor may be grasped with forceps and shelled out individually. This can be accomplished in a very few seconds. When the fatty tumor is diffuse a careful dissection of the entire mass is necessary.

SEBACEOUS CYSTS

Sebaceous cyst, *wens or atheroma*, are retention cysts caused by the obstruction of the duct of the sebaceous gland with the consequent accumulation of sebum and desquamated epithelium. The wall of the cyst is composed of connective tissue lined with secretory epithelium so that a cure is not affected unless all of the sac is removed. The secretion may be fluid, semisolid, cheesy or purulent, with or without a terrifically foul odor.

Broders and Wilson distinguish between sebaceous cysts and keratomas, both called wens. They state that "true" sebaceous cysts contain a fatty material which gives off a strong odor; keratomas, on the contrary, unless infected or badly degenerated are practically odorless. Many lesions diagnosed as sebaceous cysts or wens clinically, when examined microscopically are found to be made for the most part of

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keratin and not sebaceous material. There is considerable evidence to support the belief that these lesions are tumors that arise in the ducts of the sebaceous gland rather than from the sebaceous gland proper. For such tumors they believe that keratoma is a more accurate term than sebaceous cyst.

Fig. 1. Spina bifida.

Fig. 2. Spina bifida.

On the dorsum of the trunk particularly the scapular and intrascapular regions, sebaceous cysts may assume a larger size than in other parts of the body. Regional distribution on the back of the trunk is approximately 7.78 per cent. In size these cysts vary from a millet seed to an egg or larger. They may be globular or hemispherical in shape with or without a recognizable duct opening. They may be single or multiple, movable or fixed. The skin over them is sometimes normal in color, smooth or white if distended, red if inflamed. The absence of lobulation and the fact that sebaceous material may be expressed from sebaceous cysts, help to differentiate them from lipomas. Dermoids are congenital, are usually deep seated and noticed early in life. Fibroma molluscum is a solid pediculated tumor and multiple.

All sebaceous cysts should be removed because of the possibility of malignancy. When these tumors are acutely inflamed it is considered best to incise and drain allowing the infection to subside before excision is undertaken. These tumors can be satisfactorily removed with local infiltration. First the line of incision is infiltrated, followed by an injection below the cyst at its base. In the larger wens it is advisable to excise a section of the skin with the wen. After the skin incision the cyst may be removed intact by blunt dissection. Some of the smaller sebaceous cysts are quite hard. These may be removed merely by a small incision along its greater diameter. By pressing the index finger against the sides of the incision the entire cyst frequently shells out with its capsule. It is frequently possible to grasp the capsule of the tumors with hemostats and enucleate them from the wound even after accidentally opening the cyst.

DERMOIDS

A dermoid cyst is one of congenital origin occurring in one of the lines of embryonic closure of the skin. It may be apparent at birth or may not be noticed until some years afterward when its increase in size first attracts attention. Some dermoid cysts are made up of a single layer of epithelium with sebaceous contents in which hair is sometimes found.

Dermoid cysts containing teeth are quite rare. Fuller and Jagger reported a dermoid cyst containing teeth in the substance of the left erector spinal muscle at the level of the tenth and eleventh ribs. After excision the tumor mass was found to contain tufts of hair and sebaceous material with

two large teeth fixed to the lower edges of the eleventh rib.

If the attachment of the dermoid cyst to the deeper structures is slight its removal is almost as simple as the removal of a sebaceous cyst. Some dermoids have extensive deep attachments so that their removal is difficult.

Fig. 3. Fibrosum molluscum in a twenty-two year old woman.

Postanal Dermoids (Sacrococcygeal, Pilonidal) Cysts and Sinuses. These are encountered in the region of the sacrum and coccyx. These congenital malformations originate from faulty skin development. The predominant symptoms are due to infection with the pathological picture that of acute and chronic inflammation. Although present from birth no appreciable symptoms are noticed until adult life.

Postanal dermoids may contain hair and most frequently communicate with the skin by a small fistula or sinus. The opening of the sinus is generally in the midline between the tip of the coccyx and the anal canal and runs upward toward the lower end of the sacrum and coccyx. When the opening is not in the midline there is generally a well marked depression at this point and the existing sinus or sinuses are the result of previous operations or secondary infection in the cyst. In some cases this sinus may have its orifice very close to the anus and will simulate a fistula-in-ano. In others the orifice will be much higher, or there may be multiple openings which communicate with a cyst-like cavity. The reason for the inability to find hair in many postanal dermoids is probably due to the fact that long continued suppuration has destroyed the hair follicles.

Incision and drainage, curettement and cauterization are inadequate. Complete excision is required, and because of the fact

that hair follicles and sebaceous glands opening out of the sinus may be a little distance from the surrounding fat this

Fig. 4. Fibrosum molluscum in a twenty-two year old woman.

excision should be made with ample margin on all sides of the tract. Due to the presence of infection in the majority of these cases local or spinal or caudal anesthesia is definitely contraindicated.

In a series of 121 cases at the DeCourcy Clinic during the past five years, wide excision under general anesthesia was performed in all cases. In the presence of marked infection, the Bovie electrosurgical knife has been employed. With the use of the electrocautery unit less bleeding is encountered and the spread of infection is minimized. Since the cyst wall in these cases is adherent frequently to the fascia over the sacrum it has been found necessary to excise this structure in some cases. Of the 121, 26 had been operated previous to admission. All cases have been closed with mattress sutures of silkworm gut with as much obliteration of the blind space as possible, the skin being further closed with interlocking dermal. Many cases in which free pus was not encountered were closed without drainage with primary healing of the wound. The majority were drained and after removal of the rubber tissue drain eight days later, the wound was irrigated with Dakin's solution until complete closure occurred.

FIBROMAS

Fibromas are connective tissue new growths and may occur singly as hard or soft tumors varying in size and shape, or as multiple lesions, congenital or acquired and are often accompanied by pigmentation. On the back they are sometimes found singly as pendulous tumors of huge proportions or multiple in the condition known as fibrosum molluscum or Von Recklinghausen's disease. Fibromas are more firm in consistency than lipomas and frequently a combination of lipoma and fibroma, fibrolipoma, may occur.

MOLES (NEVUS)

One of the locations of occurrence of the pigmented mole is the dorsum of the trunk. The "nevus spilus" is a minute pigmented spot; the nevus nerrucosus is a soft flat elevation which often grows to a warty excrescence; nevus pilosus includes hair; and nevus papalaris is a papillary tumor.

Moles frequently undergo malignant change. When a pigmented nevus is in a situation where it is exposed to constant trauma, as on the back, it should be removed. The same applies to a pigmented mole which is definitely increasing in size. In general the darkly pigmented moles especially when covered by hair may in safety be allowed to remain. The bluish or slate colored smooth mole which is not appreciably elevated should be excised early or kept under careful observation. Such a lesion if irritated by constant trauma or by improper treatment may be the source of nevocarcinoma, one of the most rapidly fatal types of malignancy. Electrosurgical excision is a most satisfactory method of

removing moles. When local anesthesia is employed injection should be made a good margin from the seat of the tumor.

KELOID

True keloids are connective tissue new growths of the corium characterized by nodules, plaques or tumors of irregular shape, presenting a smooth or corrigated, whitish or reddish surface resembling a hypertrophied cicatrix.

The disease was first described by Alibert who named it on account of its peculiar claw-like appearance in some cases. It is difficult to distinguish between a true and spontaneous or idiopathic keloid and the false or spurious form which is in reality a hypertrophic scar. Hypertrophic scars are limited to the area of injury while true keloid spreads indefinitely without limitation. The common form consists of a central mass of varying proportions with claw-like prolongations extending from the periphery. The lesions vary in size from that of a small pea to that of the palm or larger. When developed to an extreme degree lobular and tumor-like growths are often seen. The most frequent site of the disease is the anterior surface of the chest. It is also observed on the back in the scapular and intrascapular regions. Surgical removal followed promptly by roentgen ray therapy gives the best results.

OSTEOMATA (EXOSTOSIS)

These benign overgrowths of bone rarely occur from the bony structure of the back. During the past three years we have encountered one such tumor mass. An osteoma, arising from the posterior superior iliac spine, was approximately 8 cms. in diameter. With chisel and rongeur the tumor mass was readily removed.

SPINA BIFIDA

Spina bifida is a congenital lesion characterized by failure of closure of one or more of the vertebral arches and in the ordinary form with herniation of the contents of the spinal canal. Two factors seem to be present in the formation of this condition, namely, the arrest in the development of the vertebras associated with incomplete separation of the neural tube from the skin and faulty cerebrospinal circulation (increased pressure of the cerebrospinal fluid).

The structures involved enter into the process in varying degrees. The simple form is a cleft of one or more vertebral arches with herniation of the meninges, or meningocele. The second degree contains definite neurological elements in the hernial sac or meningo-myelocele. The third, which is rare, is that in which the neurological elements form a part of the hernial sac and the fluid is contained in a dilatation of the central canal. In most instances the skin and the meninges are fused and the skin is so thin that it seems to be entirely lacking, the sac being a glistening transparent membrane of paper thinness.

An unusual form but one sometimes encountered is that in which there is a rounded, fatty or fibrous tumor often pedunculated protruding through a cleft but without any demonstrable meningeal sac. This may be the simplest form of spina bifida, one without meningeal involvement or it may represent the spontaneous intrauterine cure of a small meningocele.

Spina bifida is one of the most serious of the congenital defects. If there are neurological elements involved it almost always means a greater or less degree of paralysis below the defect and as this paralysis is caused by involvement of nerve elements in the sac it is seldom if ever improved by surgical intervention. In considering indications for operation it must be remembered that spina bifida is a condition in which the patient has nothing to lose and everything to gain by operation even though a certain number of cases of successful operation later develop hydrocephalus. Early operation is indicated, that is, as soon as the general condition of the child permits. Spina bifida is most common in the lumbar region but may occur in the lumbosacral, cervical or dorsal regions of the spine. There is great varia-

tion in the size and shape of the sac. In some instances a large sac may be connected with the cerebrospinal space by a small opening, the whole pedicle being very small. In others there is a long wide opening into the neural canal, the spread-out cord lying in the bottom of a shallow trough. In the first instance the problem is simple and obvious but in the latter it is much more complex. Each case must be handled on its own merits. There must be attempted a reconstruction as well as possible of the normal dural sac.

The general method of surgical procedure now consists in excision of the excisable portion of the sac, with the return to the spinal canal of returnable portions and the protection of the gap by means of superimposed flaps of muscle and aponeurosis. Flaps of bone and plates are being abandoned.

Spina bifida occulta is a congenital malformation consisting of a cleft in one or more vertebras without a meningeal sac showing on the dorsum of the body. Spina bifida occulta exists far more commonly than is realized and without any appreciable symptoms. It occurs most frequently in the lumbar region, and next in the lumbosacral region. Occasionally with spina bifida occulta paralysis ensues from birth or occurs at a later date. The outstanding symptoms are loss of bladder or sphincter control, loss of sexual power, anesthesia of the feet, toe drop, etc. Treatment consists of exploratory laminectomy, with relief of pressure from whatever cause, on the delicate roots particularly those of the second sacral segment.

SUMMARY

A list of the most common benign lesions occurring on the back have been considered briefly with their treatment. This article is not meant to be an exhaustive treatise on the subject but rather a practical ready reference.

REFERENCES

Bickham. Operative Surgery.

Breidenbach, Lester and Wilson, Lynn. Pilonidal cysts and sinuses. *Ann. Surg.*, 102: 455, 1935.

Broders, A. C. and Wilson, E. *Surg. Cl. N. A.*, 10: 127, 1930.

Christopher, Frederick. Minor Surgery. Phila., W. B. Saunders Co.

Foote, E. M. Minor Surgery, Ed. 3, New York, D. Appleton, 1912.

Fuller, C. B. and Jagger. *Brit. Jour. Radiology*, 32: 176, 1927.

Mixter, Wm. S., m.d. Spinal Column and Cord.

Ormsby, O. L. Lewis, Surgical Diseases of Skin. Hagerstown, Md., W F. Prior Co.

HEMORRHAGE FOLLOWING TONSILLECTOMY

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HEMORRHAGE is the most frequent and most feared complication of tonsillectomy and is the most important phase of tonsil operative work. In the early Christian era, Celsus[1] wrote of the removal of tonsils in his De Re Medicina. He spoke of "The proper remedies used to arrest hemorrhage." The writings of Paul of Aegina,[12] who lived in the seventh century, contain some interesting instructions regarding the control of hemorrhage following the tonsil operation. He wrote: "If any hemorrhage comes on we may use a tepid decoction of brambles, roses and myrtle leaves; or, if the blood flows copiously we must give for a gargle the juice of plantain and comfrey, copiously and the trochisk from amber and the Lemnian earth, dissolved in oxycrate." There have been occasional references to tonsil surgery and the use of the cautery and escharotics for the control of hemorrhage, through the centuries.

The popularity of the tonsil operation and the frequency of its performance kept pace with the improvement of the instruments and the techniques involved. Mackenzie[8] designed what can be called the forerunner of the present day guillotine when he modified the type of instrument originated by Physick[13] in 1827. It was not, however, until Whillis and Pybus[19] in England, and Sluder[17] in this country almost simultaneously brought forth their instruments and the simplified operations which went with them that the tonsil operation became tremendously popular. Both the skilled and the unskilled took it up and have been performing this operation in great numbers.

The popularity of the operation and the fact that it has been made available to anybody who had access to the instruments, regardless of his qualifications, are probably the greatest considerations in the matter of postoperative hemorrhage, and many of the other complications which have been known to accompany tonsillectomy. Yet a certain number of hemorrhages which could be prevented are occurring daily. The occurrence of hemorrhage is embarrassing to the physician and distressing to the patient and his family. Many physicians have been maligned unjustly by the patient and his relatives because of this unfortunate occurrence. Patients come to us apparently healthy and cannot comprehend a serious complication.

Everything should be done to insure the patient against any form of complication following a tonsil operation. He should be examined by his physician before operation. Blood dyscrasias or general systemic conditions which might make the patient a risk should be sought. No patient should be operated upon whose bleeding habits are not carefully considered. Coagulation and bleeding times should be taken preoperatively wherever possible.

For many years a coagulation test has been performed routinely in most hospitals. The failure to use this test might prove embarrassing from a medicolegal standpoint, although it has been shown by Richards,[14] Hunt,[5] McKinney,[10] Jones[6] and others that this test is not reliable. Jones, who is in charge of an unusually large tonsil clinic, does not perform the coagulation test routinely. He says: "Many patients whose coagulation time is lengthened, do not bleed as much as those whose time is normal." Our experience with this test is in accord with that of the authors just mentioned.

It has recently been demonstrated that severe hemorrhage may follow any type of operation in an individual who is suffering from vitamin C deficiency. This deficiency

may be only moderate, but can create a mild scurvy.

Some bleeding must be expected with each tonsil operation. Such a thing as a bloodless operation does not apply to the operation as it is done today. It should be our aim to have no bleeding immediately after operation, or for several days following.

Very few well trained and experienced individuals have met with so serious an experience as death from hemorrhage. Today, in the hands of the well trained, with modern instruments and technique, death from hemorrhage following tonsillectomy does not occur. A good knowledge of the anatomy involved, together with an understanding of tonsil surgery, and the exercise of reasonable care, insures a minimum of trouble.

Severe hemorrhage occurs occasionally, but it occurs with little frequency in well organized hospital practice. As evidence of this, during the years 1931 to 1935 inclusive, 10,305 tonsillectomies were performed at the Kings County Hospital. Not a single death resulted from hemorrhage, although there was one death which was related to the anesthetic. An even more striking experience is that recorded by Jones.[6] In a series of 52,467 tonsillectomies there were no deaths directly due to hemorrhage. Martin[9] reported 14,690 tonsillectomies and no deaths. These statistics indicate that removal of tonsils and adenoids, when properly planned and executed by well trained and competent operators, carries very little risk. Certainly the danger of serious hemorrhage is held to a minimum.

The following table represents the number of operations and the severe hemorrhages which required treatment during three years:

Year	Operations	Severe Hemorrhages	Percentage
1931	1159	11	.95
1932	1446	19	1.31
1935	2193	39	1.77
Total..	4798	69	1.44

Richards[14] recorded 6 serious hemorrhages in 500 operations, a percentage of 1.2, while Tilley[18] had 4 hemorrhages in 670 cases for an average of 0.6 per cent. In Martin's series the primary hemorrhages range between 0.35 and 0.77 per cent; in Jones' series the primary hemorrhages amounted to 3.25 per cent, while the secondary hemorrhages were 1.25 per cent.

That deaths have occurred and very likely still occur is indicated by the answers to the questionnaires which Hill[4] and Hanau Loeb[7] sent several years ago. Hill's questionnaire revealed 27 deaths from hemorrhage, while that of Loeb disclosed 62 deaths from this cause, 19 from general sepsis, 7 from meningitis and 21 from undetermined causes. At that time Loeb stressed that "Many of the cases reported carry with them important lessons of indication and contraindication, of inexpertness, of danger of multiple operation and postoperative inattention and of unforeseen accident." Among his cases were death from hemorrhage due to myelogenous leukemia and hemophilia.

The greater variation in mortality figures would indicate the wide difference in the methods employed and the difference in organization and personnel which is involved. The figures quoted from three clinics:

Jones.....	Manhattan Eye and Ear Hospital	52,467
Martin....	Royal Infirmary, Edinburgh	14,690
Myerson...	Kings County Hospital	10,305
		77,732

without a single death from hemorrhage, are significant. The only inference which one can draw is that the operations were performed by experts or supervised by such in a well regulated and well organized operating unit.

The organization of the ward or floor where the postoperative care is carried out is of equal importance to the organization of the operating room. Nurses assigned to tonsillectomy cases should have special training in this work. Nurses who are not so specially qualified may fail to appreciate

such symptoms of bleeding as constant swallowing, restlessness, increased pulse rate, and pallor. The surgeon should warn the nurse whose competency he may doubt, that she should not rely upon her own judgment, but should, rather, notify the house surgeon or special resident in case of doubt. Nurses in small private hospitals should be warned not to be reluctant to call the surgeon, regardless of the hour. The pulse rate should be counted every ten minutes during the first two hours after operation, and at least frequent intervals as the time passes. In cases of severe hemorrhage it is not fair to depend upon the interne to control the bleeding. Somebody well trained and experienced should respond.

A knowledge of the causes is important if we are to have less of this complication. At the top of the list I would place improperly and poorly executed operations under unfavorable conditions. It should be emphasized that the doctor's office is not considered the best place for the performance of the tonsil and adenoid operation. Nor is it the best place for the care of these patients. Tonsillectomy is not a minor operation. Most of the hazards which are involved in tonsillectomy and its after care are due to ignorance, indifference, inexperience or carelessness in some phase of the operation. It is therefore urged that the operation be done in a well organized hospital where careless and hurried work under unfavorable conditions is not only not permitted but practically impossible.

The causes of hemorrhage following the tonsil operation might be listed as primary, recurring and secondary. Primary hemorrhage is considered to be hemorrhage that is present at the time of operation and continues unchecked after the patient leaves the operating room. Recurring hemorrhage is that which has reappeared soon after operation. Secondary hemorrhage is that which occurs sometime after operation, usually after twenty-four hours have elapsed. Secondary hemorrhage has been known to occur as late as ten to fourteen days after operation.

CAUSES OF PRIMARY HEMORRHAGE

1. Failure to control bleeding at the time of operation;

a. Remnant of tonsil or adenoid tissue left behind,

2. The presence of acute or subacute inflammation at the time of operation;

3. Vitamin c deficiency;

4. Blood dyscrasias; as severe secondary anemia, pernicious anemia, leukemias, hemophilia, purpura, Hodgkin's disease;

5. Cardiac conditions, atherosclerosis, hypertension;

6. Anomalies of blood vessels;

7. Menstruation.

RECURRING HEMORRHAGE

Usually due to yelling, crying, struggling, straining or coughing shortly after operation, and is readily confused with primary hemorrhage.

Secondary Hemorrhage. 1. Stress or strain,

a. Sexual excitation;

b. Emotional strain;

c. Undue physical exertion; forceful yawning has caused secondary hemorrhage by stretching the healing wound and tearing blood vessels.

A hurried and rough tonsillectomy results in undue injury to the tonsillar fossa, with a resultant increase in bleeding. It is important that the operation be done deliberately, gently and with the excecise of care. When so performed the amount of bleeding is greatly reduced.

Let us consider the various causes of hemorrhage following tonsillectomy which are not directly related to technique:

1. The presence of acute or subacute inflammation. The increased blood supply which is present because of active inflammation may be the cause of embarrassing bleeding.

2. Vitamin c deficiency. While visiting the Harper Hospital in Detroit last Summer I was impressed with the work which had been done on the relationship of Vitamin c deficiency to obscure or unexpected postoperative hemorrhage. It was pointed out

that individuals in all stations of life may be prone to hemorrhage following operation because they have avoided the ingestion of fresh fruits.

3. Blood dyscrasias. The influence of a pathological condition of the blood cells upon coagulation and bleeding is well known.

4. Cardiac, hypertensive and atherosclerotic conditions. The local tissues will show evidence of stasis or passive congestion in certain cardiac conditions. The hypertensive and atherosclerotic individuals bleed more than is usual, for obvious reasons.

5. Menstruation. We do not agree that there is any danger of increased bleeding in the menstrual state. We do feel, however, that the prospective patient will withstand her operation and period of convalescence better if the operation is performed at a time other than during the menstrual period.

6. Anomalies of blood vessels. The pharynx should be inspected for abnormal pulsations. If such exist and the position of the internal carotid artery cannot be ascertained, it might be advisable to cancel the operation.

7. Sexual excitation is a much more frequent cause of secondary hemorrhage than is generally known. A careful check of the causes of secondary hemorrhage in hospital and private practice revealed this to be the most frequent factor in this type of bleeding. Physicians should have no compunction about warning their patients concerning this cause of late bleeding following tonsillectomy.

8. Infection occurring in the tonsillar wound will cause softening of the occluding clot in a blood vessel and its extrusion. This causes the most troublesome type of tonsillar bleeding and may recur every few days.

The accompanying reproduction of drawings originally published by Fetterolf[2] illustrates the blood supply of the tonsil (Fig. 1). The lateral or attached surfaces presents a thin but firm fibrous capsule which is continuous with the pharyngeal aponeurosis and is in contact laterally with the superior constrictor muscle of the pharynx. On the lateral surface of the superior constrictor muscle is the thin buccopharyngeal fascia. The ascending pharyngeal and ascending palatine arteries and the tonsillar branch of the external maxillary artery are in relation with the structures forming the tonsillar fossa from behind forward. The tonsillar branch of the dorsalis linguae artery approaches this region from below, while the descending palatine approaches it from above. The peritonsillar and pharyngeal venous plexuses are related to the anterior surface of the buccopharyngeal fascia and the superior constrictor muscle. If the operation is carried beyond the superior constrictor fibres, these blood vessels will be endangered. At times the superior constrictor is extremely thin and almost absent, so that the tonsillar capsule will be very close to the arteries and veins. Because of this the integrity of the superior constrictor muscle and the thin facsia beyond it must be maintained.

There are four principle arterial branches which supply the tonsil:

1. Anterior tonsillar artery—branch of the dorsalis linguae.

2. Superior tonsillar artery—branch of the descending palatine.

3. Posterior tonsillar artery—branch of the ascending pharyngeal.

4. Inferior tonsillar artery—branch of the dorsalis linguae.

According to Schaeffer[15] there is usually a distance of 2.5 to 3.5 cms. between the superior constrictor muscle and the internal and external carotid arteries. Occasionally however, the internal carotid artery may be very tortuous, creating abnormal pulsations in the pharyngeal walls. Although there are no branches coming from the cervical portion of the internal carotid artery, the ascending pharyngeal, occipital, and lingual branches may occasionally arise from it. So that a tortuous internal carotid artery might come very close to the capsule, or its ascending pharyngeal branch might be dangerously close. Schaeffer[15] reported 3 fatalities due to hemorrhage complicating tonsillectomy as a result of injury to tortuous and closely placed

internal carotid arteries. In these cases the usual distance between the tonsillar bed and the artery was no longer present.

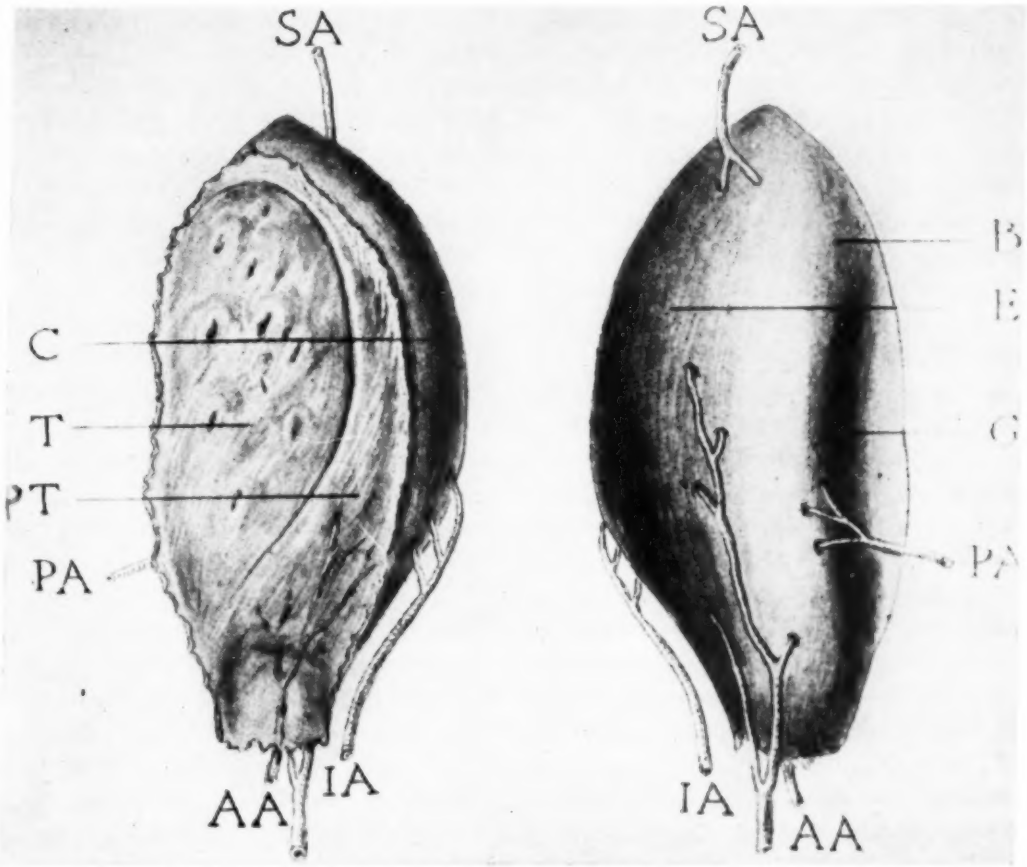

Fig. 1. Left tonsil with arterial supply, slightly enlarged (*after Fetterolf*). 1, mesial aspect; 2, posterolateral aspect. T, tonsil tissue; PT, plica trangularis; C, capsule; AA, anterior tonsillar artery; PA, posterior tonsillar artery; SA, superior tonsillar artery; IA, inferior tonsillar arteries; E, lateral surface; B, posterior surface; G, groove for palatopharyngeus.

SYMPTOMS

One would expect that bleeding from the tonsillar wound would be evidenced by the expectoration of fresh blood in all cases. Unfortunately this is not so, especially in those patients who have had a general anesthetic and are not yet fully awake. If such a patient is placed in the prone or semi-prone position immediately after operation and kept so until he is fully awake, blood will be detected coming from his mouth, if he is bleeding.

Constant swallowing is an important sign of bleeding and one should closely watch for it in the patient reacting from a general anesthetic. In addition, restlessness and an increased pulse rate indicate bleeding and should lead to an examination of the pharynx. It is therefore of great value to have the pulse rate recorded as a routine every ten minutes during the first two hours, and at less frequent intervals as the time passes. A gradually increasing pulse rate is indicative of loss of blood. Vomiting should be closely watched. This symptom is expected in most general anesthesia cases. If fresh blood appears in such vomitus, however, bleeding should be suspected. If the patient should vomit a second time it would indicate that he is very likely bleeding. A rapid pulse, pallor and restlessness are late and urgent symptoms. It is preferable not to wait for these to occur.

TREATMENT

Of first consideration should be the prevention of hemorrhage. Let us consider each cause from this standpoint.

1. Failure to control bleeding at the time of operation. The operator should be certain that remnants of tonsil or adenoid tissue are not left behind.

2. The presence of acute or subacute inflammation at the time of operation. The recognition of such a local condition and the postponement of the operation present no problems.

3. Vitamin c deficiency. All patients should be given extra fruit juices for two or three days prior to the time of operation.

4. Blood dyscrasias. Careful history taking and physical examination will eliminate this cause of trouble.

5. Cardiac, hypertensive and atherosclerotic conditions. When operation must be done, careful supervision by an internist is essential. He should advise the surgeon when it would be best to operate.

6. Menstruation. We do not feel that there is any basis for the claim that the coagulability of the blood is unfavorably influenced during the menstrual period. However, we prefer to perform the operation at other times, when the individual is in better physical condition.

7. Anomalies of blood vessels. Pulsations indicative of such abnormality are usually present in the pharynx. One should be prepared for carotid ligation in the presence of anomalies. Fortunately, these conditions are extremely rare.

Recurring hemorrhage, which is usually due to yelling, crying, struggling, straining, or coughing shortly after operation, can best be avoided by the use of appropriate sedatives when the patient is returned to bed. For this purpose codeine or codeine and aspirin suppositories are of great value.

Secondary hemorrhages other than those due to infection of the wound can be avoided by carefully instructing the patient against emotional and physical types of stress and strain. The frequent role of sexual excitation as a cause of secondary hemorrhage is stressed. Infection of the wound and loosening of the clot in the occluded blood vessel can best be avoided by strict adherence to asepsis during operation.

Hemorrhage occasionally occurs at the site of removal of the adenoid tissue. Our view is similar to that of Jones, who contends that the curette causes more bleeding than the LaForce or blade type of adenotome. It is well to inspect the nasopharynx by elevating the soft palate with a suitable instrument before using any instrument in this region. At times inspection will disclose that no adenoid tissue exists. In such a case the blind, routine use of a curette or adenotome will result in unnecessary injury to the tissues.

Bleeding from the adenoid region is best controlled by pressure with a firmly fitting sponge. If this does not suffice to stop the bleeding, the soft palate should be elevated and a hemostat used upon the bleeding point. Pressure usually suffices to stop bleeding in this region; it is rarely necessary to tie a bleeding vessel.

Primary hemorrhage should be dealt with at the operating table. If for any reason a patient has been sent to his bed and is still bleeding, it is preferable to take him back to the operating room. A patient who has previously had a general anesthetic should be reanesthetized unless the bleeding can be readily controlled. An adult who has had local infiltration anesthesia should have the benefit of some additional anesthetic before instrumentation of any extent is carried out. The reanesthetization enables the surgeon to work more smoothly.

How should bleeding at the time of operation be handled? We must presuppose that every precaution has been taken and that the operator has performed a gentle, clean, deliberate, careful and complete operation. It should be remembered that each blood vessel has its retraction time and that it takes a few minutes before the process of coagulation is completed. The gentle placement of a gauze sponge in the tonsillar fossa for a few minutes will prevent unnecessary loss of blood during this process. Bleeding may come from anywhere in the fossa. Three points which are especially difficult to reach are high up in the fossa; low down in the fossa; and behind the anterior pillar. Isolate and tie off the

bleeding point. If this is not possible, pack a piece of gauze into the fossa and leave it there for six to eighteen hours. It might be necessary to suture through the tonsillar pillars in order to hold the gauze in place. In fact, it is the safer thing to do. When bleeding is from the posterior aspect of the anterior pillar it is often necessary to evert the pillar to bring the bleeding point into view.

A suction apparatus and a proper suction tip is indispensable in this operation. The suction, however, should be used gently and for brief periods of time. It must be remembered that unnecessary and rough use of the suction tip will cause bleeding.

If there is still active bleeding after the removal of the gauze sponge, suitable hemostats of the Carmolt or Kelly type should be used to clamp the vessel. If the vessel is very small the mere crushing with the hemostat will suffice. If bleeding still continues a ligature should be tied around the bleeding point. This is done in the same manner as the surgeon ties a ligature when performing intra-abdominal or pelvic surgery. Special ligature carrying and tying instruments are available for those who do not wish to use the usual hemostats.

If the bleeding is general and comes from several different places, so that it cannot be localized, the quickest and easiest method of handling it is to sew a sponge into the tonsillar fossa. The suture should always pass through the posterior pillar first because the extreme thinness of the anterior pillar permits the needle to tear the tissues if the suture passes through that structure first. A single suture through the pillars will usually suffice to hold the sponge in place. On rare occasions a second suture may be required. It is best first to place the suture before introducing the gauze sponge. This is held directly beneath the loop of the suture with a hemostat. A non-slip knot should be used in tying. The gauze and suture may be removed in twelve to twenty-four hours.

At times it becomes necessary to use a suture ligature instead of a simple ligature in the tonsillar fossa. In many instances this is very difficult. Therefore the placement of a gauze sponge in the fossa makes a good substitute. An objection which seems to have some basis is that the needle which carries a suture ligature may infect the deep tissues of the neck.

Many laryngologists use caustics, styptics, and astringents for bleeding from the tonsillar fossa. These are not only unnecessary but, in many instances, are harmful. Such medicaments as silver nitrate, tincture ferrichloride, Monsell's solution, peroxide of hydrogen, are of no value when a blood vessel has been cut. Even when there is fine capillary oozing, these agents tend to devitalize the tissues and favor secondary hemorrhage. Peroxide of hydrogen is a dangerous agent to use for this purpose. It is used extensively, yet it is a well known fact that peroxide dissolves fibrin and disturbs the process of clotting. It causes a foam which can so obstruct the larynx as to shut off the air and endanger the life of the patient. This is especially true where the bleeding is active. The writer knows of a case where tracheotomy became necessary because peroxide was used.

The use of clamps of the Mikulicz type is popular in some quarters. These instruments act as a vise between the jaws of which are placed the tonsillar fossa and all the structures to and including the skin. This is a painful and uncomfortable procedure which should rarely be necessary.

Medications which have a physiological basis, such as thromboplastin, hemostatic serum, kephalin, coagulose, coagulen and similar products are of value in general oozing. Greene[3] advocates the use of the hemostatic properties of the patient's own tissues. He employs the placement of the detached tonsil in the fossa for control of hemorrhage during and after the operation.

A clot in the tonsillar fossa indicates a bleeding point underneath. The clot should be gently removed and the hemorrhage treated as mentioned. When controlling hemorrhage in the ward or in the patient's room good light and a suction apparatus are essential. Therefore the laryngologist who treats a case of posttonsillectomy

hemorrhage should take his suction apparatus with him.

Secondary bleeding may be more difficult to control. This is especially true in the cases due to infection. In such a case bleeding occurred every two or three days for twenty-one days after operation.

A rare but serious type of complication is that of hemorrhage into the soft tissues about the tonsillar fossa. Schall[16] had a patient who, after a tonsillectomy under general anesthesia, developed a hemotoma of the soft parts, which threatened to asphyxiate him. A tracheotomy was necessary.

Transfusion is universally used for replacing lost blood and, therefore, need hardly be mentioned.

As a final word, let us emphasize that tonsillectomy is a major operation and that the same attitude should obtain in this procedure as toward all other major surgery.

SUMMARY

The paper contains a short, historical note on the subject of hemorrhage following tonsillectomy. The causes of hemorrhage which are listed, are divided into primary, recurring, and secondary. Consideration is given to avoidance of hemorrhage by attention to these causes. Two causes of hemorrhage complicating tonsillectomy which are not generally known, are stressed. As a cause of primary hemorrhage vitamin c deficiency plays an important role in many cases. Because of this the author gives his patients fruit juices for two or three days prior to the time of operation. Sexual excitation is the most frequent cause of secondary hemorrhage in the writer's experience.

Death from hemorrhage should not occur in the light of our present knowledge; 77,732 tonsillectomies are listed from three different clinics without a death from hemorrhage.

Tonsillectomy is not a minor operation. Improperly and poorly executed operations under unfavorable conditions are frequent factors in severe hemorrhage. Most of the hazards in tonsillectomy and its after care are due to ignorance, indifference, inexperience or carelessness. For this reason such operations should be done in well organized hospitals. A deliberate, well planned and careful operation will insure a minimum of complications. The treatment of hemorrhage is outlined and various methods evaluated.

REFERENCES

1. Celsus. Quoted by Packard, Francis R., ref. 11.
2. Fetterolf, George. The safeguarding of the tonsil and adenoid operation. *Am. Jour. Med. Sc.*, 164: 884. (Dec.) 1922; Anatomy of the tonsil. *Am. Jour. Med. Sc.*, 144: 37 (July) 1912.
3. Greene, Joseph B. Further experiences in the use of tissue juices. *Boston Med. and Surg. Jour.*, 189: 200 (Aug. 9) 1923.
4. Hill, L. G. Hemorrhage following tonsillectomies. *Journal-Lancet*, 39: 170 (April) 1919.
5. Hunt, W. M. Coagulation time prior to tonsillectomy. *Ann. Otol. Rhinol. and Laryngol.*, 36: 187 (March) 1927.
6. Jones, David H. Preparation and management of patients prior to and during the tonsil operation. *Tr. Am. Acad. Oph. and Oto-Laryngol.*, 39: 327, 1934.
7. Loeb, Hanau. Further studies of fatalities following operations on the nose and throat. *Ann. Otol. Rhinol. and Laryngol.*, 32: 1103 (Dec.) 1923.
8. MacKenzie, Morrell. Diseases of the Pharynx, Larynx and Trachea. New York, William Wood & Co., 1880.
9. Martin, G. E. Complications following removal of tonsils. *Jour. Laryngol. and Otol.*, 37: 80 (Feb.) 1922.
10. McKinney, Richmond. Coagulation test. *Arch. Otolaryngol.*, 6: 158 (Aug.) 1927.
11. Packard, Francis R. Some historical considerations on the removal of tonsils. *The Practitioner*, 124: 59 (Jan.) 1930.
12. Paul of Aegina. Quoted by Packard, ref. 11.
13. Physick, Philip S. Case of obstructive cough, etc., with instrument—also for excision of scirrhous tonsils. *Am. Jour. Med. Sc.*, 1: 262 (Feb.) 1827.
14. Richards, George L. Report of five hundred cases of consecutive tonsillectomies, etc. *Boston Med. and Surg. Jour.*, 192: 304 (Feb.) 1925.
15. Schaeffer, J. Parsons. Aberrant vessels in surgery of the palatine and pharyngeal tonsils. *J. A. M. A.*, 77: 14 (July) 1921.
16. Schall, LeRoy A. Hematoma of the soft tissues necessitating tracheotomy. *Laryngoscope*, 36: 666 (Sept.) 1926.
17. Sluder, Greenfield. Technique of tonsillectomy. *Proc. A. M. A., Sect. L. R. and O.* (June 9) 1910.
18. Tilley, Herbert. Discussion on problems presented by hemorrhage in tonsil operations, etc. *British Med. Jour.*, 2: 431 (Sept. 17) 1921.
19. Whillis, S. S. and Pybus, F. C. The enucleation of the tonsil with the guillotine. *Lancet* 2: 875, 1910; *Brit. Med. Jour.*, 2: 1402, 1911.

PERITONSILLAR ABSCESS

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PERITONSILLAR abscess, or quinsy, is defined by its name. It is an abscess outside of or beyond a tonsil and hence lies between a tonsil and its muscle bed, usually involving the faucial or palatal tonsil but it may also be the lingual tonsil. The latter type of peritonsillar abscess is rare but when it does occur the tongue as well as the adjacent neck may become seriously involved. In quinsy the patient is greatly distressed but is usually not septic nor too ill to cooperate. Thus treatment of this condition may be accomplished at home and sometimes in the office.

Peritonsillar abscess develops as a complication to tonsillo-pharyngitis. The virulence of the invading organism, the obstruction to drainage of tonsillar crypts due to exudate and debris in the lacunae, and the amount of edema all contribute toward a peritonsillitis and pharyngeal myositis, the latter causing the pain on swallowing. Sometimes a supratonsillar crypt well covered over by the supratonsillar mucosal fold or plica, runs deeply through the tonsil almost to the tonsil capsule and must contribute greatly to the incidence of peritonsillitis. It is because of this sinus supratonsillaris that the most frequent development of abscess occurs about the upper tonsillar pole.

When peritonsillitis is developing and abscess formation is likely, great caution must be exercised and any incision avoided, either into the tonsil or the palate. Incision into a tonsil at this time has apparently been the cause on a number of occasions of tonsillar abscess, a condition likely to produce sepsis and death. As the peritonsillitis develops in the loose tissues about the tonsil, abscess formation occurs, usually superior and external to the tonsil and causing protrusion of the palate forward and dislocation of the tonsil medially and somewhat downward. Any extension downward behind the tonsil or abscess formation independently near the tonsil base causes great edema because of venous obstruction. As the quinsy develops dysphagia is great and stout fixation of the jaws is characteristic because any motion here increases the great pain and distress.

Because of the edema and the fixation of the jaws the tonsil itself is difficult to see. But the supratonsillar fold or plica can usually be observed and so can the red and swollen palate which is projected forward. Thus the two surgical approaches are at hand despite the inability of the patient to open the mouth more than very little. It must be remembered that the tonsil always occupies a fossa the upper part of which is always domed into the palate above the base or the root of the uvula. The tonsillar vessels enter the fossa through the top of this vault and also near the tongue base. If the base of the uvula is used as a guide one may be certain that the blood vessels enter the fossa at a higher level than this. Also they quite invariably lie in or on the posterior and external muscle walls. Thus incision of the usual supratonsillar abscess may be accomplished with very reasonable safety if these points are kept in mind.

Operation is best accomplished without anesthesia. Local anesthesia is of little value. Swabbing causes pain. Tension, as well as spread of the infection is likely if infiltration is attempted. Spray anesthesia renders so much of the pharynx unmanageable that mucus and evacuated pus might be aspirated into the trachea with self evident dangers. General anesthesia is not favorable unless one is positive that no

cooperation can be enlisted and that the abscess is such that it will not rupture during stress incident to the taking of anesthesia. Suction apparatus would of course be necessary.

When one is certain that an abscess has formed it is not necessary to permit hours or days of pain and distress to continue before operation merely to permit greater localization or larger abscess formation as a convenience to evacuation of the pus. The abscess may be incised through the palate at the site of greatest redness and fluctuation, at or just above the level of the base of the uvula. A very thin sharp blade is best. Once it has been introduced, cutting edge down, it causes no more pressure hence no increase of pain, and if some pus escapes pain is reduced. Thus, haste or quick slashing incision is unnecessary and unwarranted. If the blade is now carefully and deliberately advanced, while a slight rotary oscillation of its handle is made, vessels will not be cut, and likewise the tonsil capsule will not be entered, and the abscess depth will usually be found quite easily. If the handle is now elevated and inclined outward so the point of the knife is lowered somewhat medially, the blade can be quickly and deliberately withdrawn, thus making a real incision ½ to ¾ inch long with very little pain and definitely away from all large vessels.

A tongue depressor firmly but gently placed on the tongue up to the tumefaction, aids in the operation and protects the mouth as the withdrawn blade is brought out upon it. This procedure is the least painful, and very little if any spreading of forceps in the abscess cavity is necessary. The opening of an abscess here or elsewhere by the sudden forceful introduction of any kind of forceps, although perhaps considered safer, really need not be and certainly seems brutal.

The other surgical approach is through the supratonsillar fold. The superior border of the anterior pillar is followed to where it merges into the palate. This is usually readily seen and the supratonsillar fold can be made out quite as easily. By a small incision of this usually loose fold, followed by probes or seekers of increasing size, into the supratonsillar space as described by Dobbs,[1] or using the special threaded instrument designed by Pelz,[2] excellent evacuation of the abscess can quite invariably be obtained through this route.

Having evacuated any superior abscess, the posterior aspect of the tonsil should be visualized, and a counter or dependent incision made if an inferior abscess exists, either as a separate entity or as a sort of sinking abscess from the one above it. This is not usually necessary, and edema here should be carefully considered and not misinterpreted as an abscess. Should a clot or exudate obstruct the palatal incision, and permit reaccumulation of pus, such obstruction can be easily picked out with forceps with very little discomfort. Further incision, or spreading, unless done very gently is almost never necessary. However, it will be found that a ¾ inch incision is about half as big, as soon as the abscess is evacuated.

Hot irrigations and hot drinks, if they can be taken, benefit greatly both while localization is going on, and after drainage of the abscess. Early *x*-ray therapy may abort a peritonsillitis, and if not, hastens formation of an abscess which seems less great than was expected, and usually less tense and painful. Tonsillectomy, in the presence of quinsy abscess has been recommended and successfully done by Baum[3] and others, but is not generally an accepted procedure.

Danger points to be remembered are the vessels entering the upper part of the tonsillar fossa; the carotid artery, which is sometimes seen to pulsate the lateral wall of the fossa after removal of a tonsil; incision too far laterally, and in a lateral rather than somewhat medial direction, which

[1] Dobbs, O. R. *Laryngoscope*, 40: 186, 1930.
[2] Pelz, M. D. *Laryngoscope*, 40: 190, 1930.
[3] Baum, H. L. *Annals Otology Rhinology and Laryngology*, 35: 429, 1926.

procedure might injure the carotid or introduce infection into the neck, and not accomplish the drainage of the abscess. As mentioned before it is best not to incise into the tonsil or through its capsule. Delay in relieving the abscess might permit spontaneous pharyngeal rupture with tracheal aspiration of pus; extension into the pterygo-maxillary area with more serious abscess formation; or gravitation abscess down the neck into the mediastinum. Involvement of the glottis by edema is rare, but does happen.

Peritonsillar abscess always shows the usual signs of an abscess and definite tension of the palatal structures, and this differentiates it from tonsillar abscess, retropharyngeal adenitis or abscess, and tonsillar-palatal displacement due to new growth or cervical adenitis. Peritonsillitis occurs more commonly in adults with a large proportion forming abscess. In children it most frequently subsides. Likewise children form suppurative adenitis far more frequently. Hansel[4] reports that Guiffrida concluded from 121 of his own cases in two years that the bacteria causing abscess were pneumococci 25 per cent; streptococci 23 per cent; staphylococci 1 per cent; mixed diplococci and bacilli, chiefly colon bacillus, 33 per cent; fusospirilla of Vincent 2.5 per cent; diplococci and streptococci 11 per cent; diplococci and staphylococci 4 per cent.

Peritonsillar abscess may recur numerous times about one or both tonsils, but rarely in both in the same attack. It may be a locally distressing but otherwise uneventful disease; or it may produce the gravest sepsis with numerous metastatic complications, hemorrhage by blood vessel erosion, locally or in metastatic sites, and death. Thus, the clinical state of the patient, and the course of the disease, should determine whether or not the condition is one which can be managed as a case in minor surgery, or one calling for the most elaborate regime and support.

[4] Hansel, F. K. *Archives of Otolaryngology*, 24: 629, 1936.

CONCLUSIONS

Peritonsillar abscess occurs in the anatomic space between a tonsil and the pharyngeal muscles forming its fossa.

It usually occurs in the palatal portion of the fossa bulging the palate forward and dislocating the tonsil medially and downward delineating the supratonsillar fold. In the surgical attack the palatal bulge and the supratonsillar fold are the two approaches and both are accessible despite trismus. The base of the uvula is a surgical guide in avoiding the superior or chief tonsillar blood vessels.

Careful adequate incision is much preferred to any rupturing or blunt forceful evacuating of a peritonsillar abscess.

Local anesthesia is of little or no value and inhalation anesthesia has the danger of aspiration of discharges ever present.

X-ray therapy early is abortive or hastens localization.

Occurrence is chiefly in adults and rarely is bilateral in one attack. Recurrence is common.

Pneumococci, streptococci, and diplococci with Bacilli coli seem to account for about 80 per cent of these abscesses.

Peritonsillar abscess, a very distressing experience, may usually be managed at home and evacuated there or in the office. It may also be a most serious complicating disease requiring all the elaborate supportive measures only to be had in the hospital.

ACUTE RETENTION OF URINE

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ACUTE retention of urine represents a highly significant clinical syndrome as encountered either by the internist, surgeon or urologist. Inability to pass any urine per urethram after repeated attempts at voluntary micturition may sound a danger signal warranting not merely relief of immediate symptoms but careful investigation for underlying pathology. Too often the effect is treated with utter disregard of the cause. Morbidity and mortality would be markedly diminished if cause and effect were revealed and suitable therapy instituted.

Any obstructive lesion of the lower urinary tract, from internal sphincter to external urethral meatus, may account for complete interruption of the urinary stream. Apart from the dynamic mechanical types, one may encounter adynamic neurogenic lesions. It would be more accurate in defining acute retention of urine to include the upper urinary tract. This broader interpretation is expressed as the inability of the renal pelvis, ureter or bladder to discharge any of its urinary contents.

One should be mindful of the fact that acute inflammation with its attendant edema, either independent of, or superimposed upon anomaly, neoplasm or calculus of the kidney, renal pelvis, ureter or bladder, is capable of producing acute localized urinary obstruction. Associated with such unilateral pathology is the ever-present danger of reflex inhibition of urine on the opposite side, or even absence of the kidney, a finding noted in 0.04 to 0.1 per cent of all individuals. For purposes of simplicity, however, we shall confine our presentation to the lower urinary tract.

It is also beyond the scope of this paper to discuss chronic retention of urine. In such instances, micturition is possible though curtailed in varying degrees. The underlying pathology in both chronic and acute urinary retention may be the same. Sudden shock, overindulgence in alcohol or coitus, exposure to cold, or acute infection may convert a chronic case into an acute one.

The usual clinical picture of acute urinary retention is that of a thoroughly uncomfortable patient, with anxious facies and unable to stand still or lie quietly in bed. While pain is predominant in the majority of cases, its absence in no way alters the acuteness of the condition. An individual whose bladder sensibility is impaired or absent due to peripheral or central nervous system infection or injury demands just as much attention as the more animated type.

To complete and to clarify our conception of acute retention, one must exclude anuria, or acute suppression of urine. In both instances there occurs an inability to pass urine. The former is predicated on the presence of an excessive volume of urine in the bladder, the latter, on renal secretory inhibition. The distended viscus may be visible, dull to percussion and palpable. In anuria the bladder cannot be outlined by percussion or palpation and contains little, if any, urine, as confirmed by catheterization.

INCIDENCE

Inability to void is usually associated with urethral stricture in the youth and prostatism in the aged. Undoubtedly these two groups account for many cases of acute retention. However, no age is exempt from the incidence of underlying lesions and the precipitation of the clinical

emergency. Newborn, youth, middle-aged and aged are, as we shall show, victims of the condition.

Sex predilection is of no real significance. Acute retention occurs in the female as well as in the male. True, diseases of the prostate gland and the greater susceptibility of his urethra to gonorrheal stricture formation undoubtedly produces an incidence elevation in the male. Furthermore, the vigorous activity of boys at play and the greater number of men at work, make the male more susceptible to such injuries which may directly, or indirectly, produce acute retention. Gynecological disorders, in turn, cause numerous instances of acute obstruction to the outflow of urine in women.

ETIOLOGY

With the exception of isolated cases of hysterical or reflex (postoperative) retention of urine, careful urologic investigation will reveal a basic cause for the obstruction. Such causes may be classified as anomalies, infections, new growths, trauma, neurogenic lesions, urolithiasis, foreign bodies, psychic or reflex phenomena, and a miscellaneous group comprising rarer occurrences.

Pathological entities will be found to fall into certain age groups. Thus, anomalies frequently manifest themselves in childhood, although occasionally the condition passes unnoticed until superimposed infection precipitates acute obstruction in the adult. The twenty to forty year age group is characterized chiefly by gonorrheal strictures in the male and pelvic disorders in the female. In the group over fifty years of age, vesical neck obstruction due to prostatic disease and gynecological maladies predominate.

DIAGNOSIS

The diagnosis of acute retention of urine is usually self-evident. In most instances pain is an outstanding symptom, and its relief represents the chief immediate concern of both patient and doctor. History of antecedent urinary difficulties, injury, operation, or disease (gonorrhea, syphilis, urolithiasis etc.) may be obtained. Such conditions will be presented in greater detail as disease entities are considered.

Dribbling of urine should make one suspect a condition of "paradoxical" incontinence due to urinary overflow from an overdistended bladder. Such instances are usually associated with neurogenic diseases. An ataxic gait, sensory changes and other neurological findings readily identify the tabetic. In true urinary incontinence there is little or no urinary retention.

On physical examination, the patient may be extremely agitated, perspiring freely and tossing about. Inspection of the hypogastric region may reveal a visible midline swelling; the mass is tense and tender to touch, movable from side to side (within pain limits), with rounded upper contour and merging with the symphysis below. Percussion yields flatness over the tumor, in contrast to a tympanitic note elicited laterally and superiorly. Rectally, a cystic tumefaction may be palpated. During the course of this procedure one may disclose the cause of the condition with the finding of an enlarged or stony hard nodular prostate gland. Urethral catheterization, of course, definitely establishes the diagnosis of retention of urine.

ANOMALIES

Malformations of the urinary tract account for most obstructive uropathies in infancy. The sequel of obstruction, stasis and infection is allied with a state of chronic or acute retention of urine. Complete or partial phimosis, paraphimosis, atresia or constriction of the external meatus, strictures or atresia of the urethra, posterior urethral valves, hypertrophy of the verumontanum, and contracture of the vesical neck represent such etiological factors. In the case of complete atresia, an acute emergency exists and life-saving measures must be instituted. In other conditions, premonitory signs and symptoms usually manifest themselves but

infection often transforms a chronic obstruction into an acute one.

Complete atresia of the urethra is,

Fig. 1. Urogram demonstrating extent of obstructive uropathy caused by posterior urethral valves. (Courtesy Dr. S. R. Woodruff.)

fortunately, a rare occurrence. Many such cases pass unnoticed in the absence of postmortem examinations of stillbirths or those dying shortly after birth. Woodruff and Milbert[1] report a case of complete atresia of the urethra in a child who died one hour after birth. Autopsy revealed far advanced obstructive uropathy involving the posterior urethra, bladder, ureters and kidneys. Even timely intervention in such a case would have been unavailing, but Birdsall[2] performed external urethrotomy on a child similarly affected six hours after birth which proved to be a life-saving measure.

Congenital anomalies of the prepuce are readily amenable to treatment. A pinpoint orifice may be bluntly stretched with a probe or by spreading the blades of a mosquito clamp inserted through the tiny aperture. If necessary, a dorsal slit of the

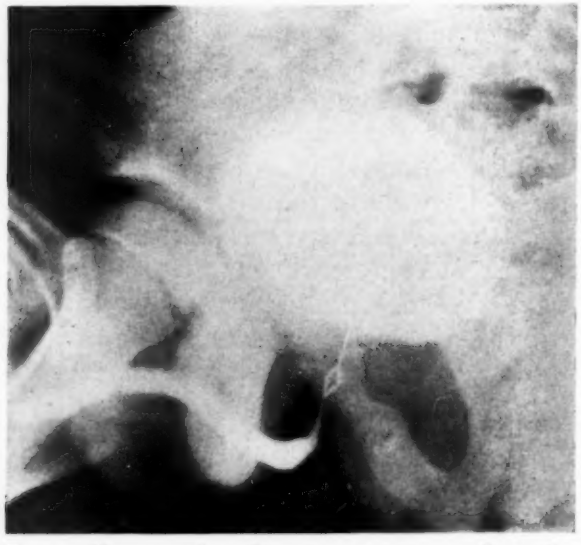

Fig. 2. Hypertrophy of verumontanum as shown by urethrocystography in a four year old boy with partial urinary obstruction.

prepuce or a circumcision can be done. Several cases of obstructive uremia have been reported due to prolonged chronic back pressure produced by extreme phimosis.

Strictures of the external meatus represent the most common form of urethral narrowing and are especially prone to complete obstruction when infection with acute inflammation and edema of the glans supervenes. In the newborn, a veil may completely occlude the meatus and simply nicking the almost translucent membrane will result in spontaneous urination and disappearance of a palpable hypogastric mass. Meatal strictures of varying calibre may be progressively dilated with filiforms and bougies or subjected to meatotomy, using a No. 11 blade or bistoury.

The attending obstetrician should assume the responsibility of noting any evident pathology of the external genitalia, the correction of which may be of immediate or remote importance. Failure of the child to void within the first eighteen hours warrants determination of the patency of the urethra. This may be done with a small bougie or catheter. Occasionally such a

procedure will separate or perforate membranous adhesions of the urethral mucosa. In extreme cases more radical surgery is indicated on the urethra or bladder. Posterior urethral valves (Fig. 1), hypertrophy of the verumontanum (Fig. 2) and contracture of the vesical neck may be remedied by using the transurethral cutting or fulgurating electrotome.

INFECTIONS

Non-specific infections are of little significance unless they give rise to an inflammatory process engrafted upon an existing point of constriction. Previously mentioned urethral anomalies, phimosis and paraphimosis are prone to produce acute obstruction when complicated by infection. Treatment is usually expectant and external lesions respond to wet dressings of boric acid, potassium permanganate or subacetate of aluminum. Gonorrhea represents a particular menace to normal urinary function. Carelessness of the patient or faulty and indiscreet manipulation by the physician may result in such periurethral edema as to obstruct the urethral channel. Periurethral abscess or phlegmon, acute prostatitis, or prostatic abscess may similarly arise and cause acute retention of urine.

Treatment of such acute inflammatory obstructions should always be conservative. Rest in bed, hot sitz baths, hot rectal irrigations, sedatives and rectal suppositories of opium and belladonna are prescribed. Usually this regime results in regression of the acute symptoms. The patient may be advised to attempt micturition while immersed in a warm bath which has a soothing and relaxing effect upon sphincter spasm and urethral congestion.

Occasionally radical steps are necessary to relieve the more acute and extensive processes. Suprapubic cystotomy, external urethrotomy or incision and drainage of an abscess may be indicated. In the case of prostatic abscess, intra-urethral rupture of the suppurative focus has been effected by blind manipulation with a sound. We prefer either the transurethral approach under vision, using the McCarthy resectoscope with cutting or fulgurating electrotomes, or perineal incision and drainage.

Suprapubic cystotomy, while outwardly a radical step, may be a most conservative and economic measure. By side-tracking the urinary flow temporarily, the affected area is put at rest with rapid involution of the inflammatory process. Urethral instrumentation can then be carried out at a later date. To attempt such instrumentation in the acute phase one faces the danger of producing a blood stream infection, urethral injury and urinary extravasation, if it is not already present.

URETHRAL STRICTURE

Because gonorrheal stricture of the urethra accounts for many cases of acute retention we have chosen to deal with it separately. Neglect, inadequacy of treatment, willful or accidental use of strong anti-gonorrheal urethral medication may result in partial or complete constriction of the urethra. Progressive diminution in the urinary stream may be noted with sudden cessation occurring after exposure to cold, overindulgence in alcohol or coitus, or too vigorous instrumentation.

Gentleness is essential in attempting to relieve such urethral obstructions. Placing the patient in a hot tub bath may result in partial relief of the acute retention. Passage of a small sized sound or bougie will indicate the approximate location and degree of the obstruction. Sterile albolene or olive oil may be instilled into the urethra as a lubricant prior to any instrumentation, or instead, a surface anesthetic of one of the various novocaine derivatives or 1 per cent diothane solution may be used and retained in the urethra with a penis clamp for ten minutes before instrumentation is attempted. A water-soluble lubricant can then be used. Any form of anesthesia will cause the operator to take greater liberties in instrumentation than necessary, with the ever present danger of further urethral damage. If deliberation and gentility are observed in the passage of filiforms, bougies

and other instruments, no anesthesia may be necessary.

Passage of a filiform bougie can be a simple or very tedious performance. Patience is a prerequisite to success, for it may take half an hour and repeated attempts with one or more filiforms before the point of obstruction is passed. The use of multiple filiforms passed parallel to one another helps to localize an eccentrically placed passage through the strictured area. The Philips whip filiform and follower or the LeFort type are especially desirable. A small-calibered ureteral catheter may serve the twofold purpose of passing a point of constriction as well as effecting slow drainage.

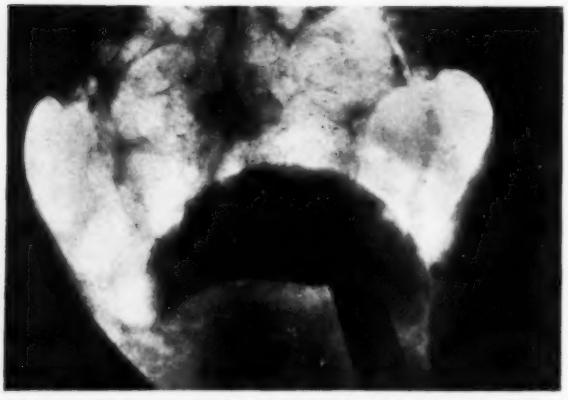

Fig. 3. Cystogram showing marked intravesical prostatic hypertrophy which caused acute retention. Suprapubic cystostomy (tube in place) was performed.

Following successful passage of a filiform, it may be left indwelling in the urethra and fastened with thread or adhesive to prevent its dislodgement. The instrument acts as a splint for the passage of urine along side of it through the edematous canal. After twelve to twenty-four hours the inflammatory process will have so subsided as to permit the passage of graduated followers of the Philips type or of ordinary bougies.

In cases where the patient is seen after repeated unsuccessful attempts have been made by others, a period of rest and sedation should be given before resuming further instrumentation. Rarely is it necessary to perform suprapubic cystotomy or external urethrotomy for the relief of acute retention. Such procedures, together with internal urethrotomy or dilatation, may be applicable in the subacute or chronic stages.

NEW GROWTHS

Prostatic obstruction due to benign hypertrophy or malignancy is the most common source of acute retention in elderly males (Fig. 3). A history of frequency, nocturia, dysuria, urgency and diminution of stream often is climaxed by acute retention. The immediate precipitating factor may be an upper respiratory infection, automobile ride, exposure to cold, alcohol or sexual excitement. It may also follow diagnostic or therapeutic measures such as cystoscopy, passage of a sound or prostatic massage.

Success in catheterizing such individuals depends upon possession of a suitable supply of catheters. An ordinary Nélaton soft rubber catheter may be sufficient. Depending upon the degree of edema, the tortuosity or distortion of the posterior urethra and the degree of elevation of the sphincter floor, one may try, in turn, a soft rubber coudé, natural curve, coudé or bi-coudé woven silk, or a soft rubber catheter threaded on a curved wire stylet to obviate "buckling" of the flexible tube. Steel catheters should be used only in extreme cases and then with caution. The smallest sized catheters should be used wherever possible to minimize trauma.

As emphasized in the treatment of urethral stricture, gentleness is paramount. Repeated unsuccessful attempts should be punctuated by a rest period both for patient and doctor. Sedation and local anesthesia can be given the patient in the meantime. A 1 per cent solution of diothane instilled into the urethral canal and retained by a penis clip will often bring gratifying results.

Having catheterized the elderly prostatic patient, gradual decompression of the chronically distended bladder should be effected. This may be carried out by drawing off four ounces of urine at one to two hour intervals or by attaching a Murphy drip tube to the catheter and regulating

the flow by a screw clamp to sixty drops a minute.

Creevy,[3] in analyzing 69 deaths following catheter treatment of retention, could find no proof that sudden decompression was the cause. However, shock, collapse, renal or vesical hemorrhage and anuria have been reported by others as direct results of sudden total evacuation of acutely distended bladders. Nothing is lost and much gained by observing precautionary measures. If too much urine has been withdrawn inadvertently, a safe procedure is to replace the fluid volume in part by sterile saline, boric acid or other antiseptic solution.

In addition to prostatism, vesical neck obstruction may be produced by benign or malignant bladder tumors at or about the internal sphincter. Just as a middle lobe may produce a ball-valve obstruction so can a pedunculated bladder tumor engage itself in the internal sphincter and lead to acute retention of urine. Inflammatory edema in prostatic or vesical malignancies can completely occlude the sphincteric lumen. Recently we encountered a case of acute retention of urine in a patient undergoing deep *x*-ray therapy for prostatic carcinoma. He had voided freely prior to the exposure to roentgen rays. Catheter drainage affords immediate relief in the mentioned conditions. Their subsequent treatment, other than immediate symptomatic relief, is not germaine to our subject.

TRAUMA

Direct injury to the urethra or pelvis may cause a protective reflex retention of urine. Rupture of the urethra is best treated by suprapubic diversion of the urinary stream to offset any extensive extravasation at the site of injury. In selective cases and in expert hands, passage of a catheter along the roof of the urethra may be attempted.

Injuries to the spinal cord with resultant compression fractures, transverse myelitis or localized nerve tissue injury result in disturbed function of the sacral and sympathetic innervation to the bladder. Diminished or absent sensibility of the bladder to urinary distention results in acute, painless retention of urine. Dribbling occurs as an overflow phenomenon and is referred to as "paradoxical" incontinence.

Catheterization of patients suffering from spinal cord injuries should not be done without specific indication. The patient may go days or weeks without voluntary micturition but a state of automatic bladder contraction will develop sooner or later. Massage, stroking the thighs or application of the Credé maneuver to the distended bladder will facilitate its emptying. Infection subsequent to catheterization in such cases is especially common and for this reason it should be avoided entirely or when done, strictest asepsis observed.

Either as a result of external trauma or urethral or vesical instrumentation, hemorrhage from the bladder wall or prostate may occur. Formation of large clots in the bladder may produce complete obstruction to the outflow of urine until they are evacuated. This may be effected through a large catheter or cystoscopic sheath and application of suction. Irrigation with a solution of boric acid and alum (15 grains to the ounce) is an effective hemostatic. In exceptional cases, transurethral or suprapubic fulguration of the bleeding points may be necessary.

NEUROGENIC LESIONS

Intrinsic central nervous system diseases, apart from those resulting from trauma, cause retention of urine. Cord tumors, syringomyelia, myelitis and tabes dorsalis are frequently complicated by urinary retention. Recent advances have been made in demonstrating altered intravesical pressure and muscle tonus in such conditions by cystometric determinations.

In tabes, one must take into account the fact that the patient is also in the age group characterized by prostatic hypertrophy. Both conditions may be present and for this reason catheterization, with judicious emptying of the bladder and use

of antiseptic astringent irrigating solutions, is permissible.

POSTOPERATIVE RETENTION

Postoperative retention represents the most common form of reflex inhibition of urination. Individuals upon whom local anesthesia is used are seldom if ever troubled. In contrast, however, spinal or inhalation anesthesia is characteristically followed by acute retention in from 10 to 50 per cent of all cases.

Butureanu and Burghele[4] report a 10 per cent incidence of acute retention after 573 spinal anesthesias, one-third of which were for lower abdominal or pelvic surgery. Jordan,[5] surveying a group of postoperative cases at the University Hospital, Philadelphia, notes an incidence of 19.3 per cent with retention following spinal, 12.5 per cent after ether, and 27 per cent after nitrous oxide-ether anesthesia.

Apparently, impulses which normally initiate the act of micturition are nullified by the anesthetic, resulting in interruption in the coordinated cycle of rhythmic bladder musculature contraction and subsequent relaxation of the sphincter. The failure of the bladder to heed Nature's call with subsequent retention is similar to the production of constipation when the desire to defecate is repeatedly denied. Barrett[6] has made the interesting clinical observation that if catheterization is done before the patient is unduly distended or at the first complaint of discomfort, two-thirds of such cases will be relieved without subsequent discomfort or danger.

Routine postoperative catheterization should be avoided except in certain gynecological operations upon the vagina or perineum, where straining and pressure is contraindicated and where residual urine commonly predisposes to acute infection. Time honored conservative measures include heat to the hypogastrium in the form of an electric pad, hot water bottle or stupes; the sound of running water; oral administration of strychnine or belladonna; subcutaneous injections of pituitrin, ergot or physostigmine; and methenamine intravenously in 30 to 60 grain doses. Potassium acetate, 15 grains every half hour for eight doses, has been advocated by Jordan to relieve internal sphincter spasm. A warm enema may frequently initiate micturition.

The average patient who has been subjected to surgery can easily go twelve to fourteen hours without catheterization. Some surgeons favor early and repeated catheterization while others absolutely forbid it. Hard and fast rules cannot be laid down but the patient should not be allowed to suffer unduly. In the absence of pain, catheterization is not indicated unless one fears anuria, and wishes to confirm such an impression. If strictest asepsis is observed, the procedure is innocuous. Curtis[7] reports on 1595 major operations in women, 34 per cent of whom required catheterization. In 275 instances where the procedure was done once or twice, none were infected; of 269 requiring relief of retention three times or more, 12 developed cystitis. Jordan's statistics are less impressive, with 9 of 37 cases catheterized developing cystitis and one an epididymitis. Cases of severe fatal urosepsis have been reported by others following simple postoperative catheterization.

As a prophylaxis against postcatheterization cystitis, germicidal solutions of silver nitrate, argyrol, protargol, neosilvol or acriflavine should be instilled into the bladder and urethra as the catheter is being withdrawn. We have found that if patients are urged to void while the catheter is in the bladder, they may force it out and continue with the urinary stream naturally. One may modify this technique by slowly withdrawing the catheter as the patient is told to void with similar gratifying results. The vicious inhibiting mechanism is thus broken and further mechanical withdrawal of urine is rendered unnecessary.

OTHER REFLEX PHENOMENA

Apart from reflex inhibition of urination after general or spinal anesthesia and from operations on the urethra, perineum or

rectum, essential sphincterospasm occurs in individuals with vegetative imbalance or psychic conflicts. The desire to void which has been denied by circumstance in a perfectly healthy individual may be followed by acute retention of urine.

Fig. 4. Cystogram depicting the distended viscus which contained 2500 c c. of urine. (Courtesy Dr. S. R. Woodruff.)

Fig. 5. Lateral view of patient in the acute retention due to hysteria showing marked abdominal protuberance. An abdominal tumor had been suspected prior to catheterization. (Courtesy Dr. S. R. Woodruff.)

Hysteria, most often evident in women, may account for single or frequent attacks of retention. No organic pathology can be found in such cases even after thorough urologic investigation. Woodruff[8] recently saw a middle-aged woman with acute retention of over two liters of urine which could only be explained on the basis of hysteria (Figs. 4 and 5). Psychotherapy resulted in no further disturbance. A similar instance was seen by us in a woman who was considerably agitated by business and familial problems.

MISCELLANEOUS DISORDERS

Gynecological conditions may occasionally produce acute retention. Uterine fibroid, ovarian cyst or retroverted gravid uterus impacted in the pelvis have been reported as causes of complete urinary obstruction. Hematocolpos behind an imperforate hymen, pelvic abscess, extreme procidentia, inflammatory edema of an urethral caruncle or even excessive vaginal packing have led to complete mechanical obstruction of urinary flow. Treatment is directed at correction of the cause, catheterization merely alleviating acute distress.

Vesical or urethral calculi, by impinging upon the internal or external sphincters or becoming impacted in the urethra can completely block the outflow of urine (Figs. 6 and 7). Urethral calculi may be crushed and removed by foreign body forceps through the panendoscope or pushed back into the bladder and converted into vesical calculi. Occasionally the stone may become so impacted and imbedded in

inflammatory tissue as to warrant external urethrotomy. Vesical calculi may be removed by cystoscopy, litholopaxy or suprapubic cystotomy.

Fig. 6. Roentgenogram showing shadow of large calculus. (Bandler and Hyams. *Am. Jour. Surg.*, 8: 836–841, 1930.)

Rectal lesions are an indirect source of urinary dysfunction. Reflex inhibition has already been cited. Tumefaction or abscess formation in or about the lower rectal segment can produce sufficient pressure upon the urethra to completely obstruct it. In radical abdominoperineal surgery, sympathetic or sacral nerve roots may be so damaged as to cause persistent urinary retention for weeks or months.

Foreign bodies represent an infrequent source of urinary obstruction. Insertion of objects into the urethra for purposes of masturbation may result in their impaction in the channel. Rings, bands, or ligatures may be playfully placed about the penis only to produce edema, constriction, and in extreme cases, actual obstruction. Treatment depends on the nature of the offending agent and the mechanical problem at hand.

Drugs have been held accountable for a few cases of acute retention of urine. Among such offenders are belladonna, opium, and cantharides. Valentine and Fitzgerald[9] presented instances of the deleterious effect of ephedrin when used in elderly asthmatics.

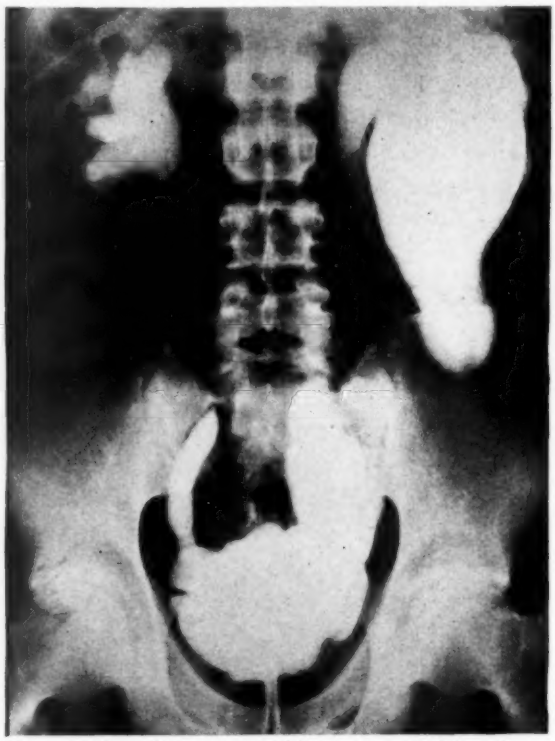

Fig. 7. Complete urographic study resulting from vesicorenal reflux of 6 per cent sodium iodide solution. This picture was made prior to complete removal of obstruction at internal vesical sphincter. (Bandler and Hyams. *Am. Jour. Surg.*, 8: 836–841, 1930.)

Sphincter spasm, pain and a desire to void out of all proportion to the quantity of urine in the bladder was noted, in addition to red blood cells, albumin and an increased number of epithelial cells in the urine.

Ephedrin stimulates the sympathetic innervation to the sphincter. Systemic signs of toxicity are palpitation, restlessness, gastric pains and giddiness. Removal of the drug is followed by subsidence of symptoms, while its resumption in sensitive cases causes exacerbation. Respect for such individual drug idiosyncrasies represents ideal therapeusis.

CONCLUSION

While acute retention of urine and its attendant discomfort represents the imme-

diate concern of both patient and physician, the latter's responsibility does not end after effecting symptomatic relief. One would be failing in his duty if he did not undertake the task of determining etiological factors involved. In some instances, the cause is readily apparent and needs no further study. On the other hand, urinary disturbance may represent the initial sign of potential or actual pathology.

No attempt has been made to exhaustively enumerate the causes of retention, although the more common and some of the less common etiologic factors have been presented. Many of the therapeutic steps outlined may be carried out in office practice but in some instances hospitalization is desirable, if not imperative.

REFERENCES

1. Woodruff, S. R. and Milbert, A. H. Congenital atresia of the urethra. Presented before Section on Urology N. Y. Academy of Medicine (Nov.) 1935.
2. Birdsall, J. C. Congenital obstruction of the urethra. *Jour. Urol.*, 22: 438, 1929.
3. Creevy, C. D. Sudden decompression of chronically distended urinary bladder. *Arch. Surg.*, 25: 356, 1932.
4. Butureanu, W. and Burghele, T. *Presse Méd.*, 35: 1414, 1927.
5. Jordan, C. G. Postoperative urinary retention. *Ann. Surg.*, 98: 125, 1933.
6. Barrett, N. R. Treatment of postoperative retention of urine. *Lancet*, 227: 104, 1934.
7. Curtis, A. H. Management of female bladder after operation and during pregnancy. *J. A. M. A.*, 80: 1126, 1923.
8. Woodruff, S. R. Personal communication.
9. Valentine, J. J. and Fitzgerald, J. S. Retention of urine due to ephedrin. *Jour. Urol.*, 34: 314, 1935.

CIRCUMCISION: SIMPLIFIED ANATOMICAL TECHNIQUE*

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THE object of this paper is to describe an operation which has the advantage of improving the esthetic results following circumcision. The technique is based upon sound anatomic principles, the skin and the mucosa being approximated by the same ligatures used to ligate the three main arteries.

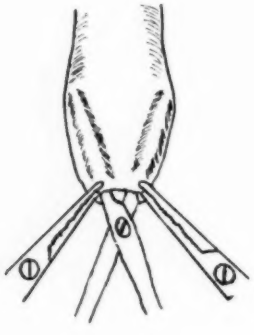

FIG. 1.

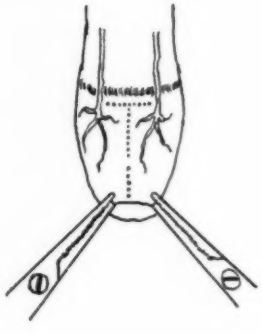

FIG. 2.

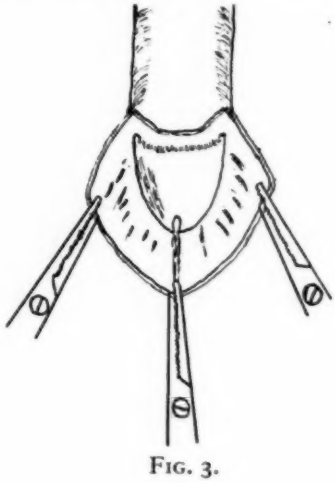

FIG. 3.

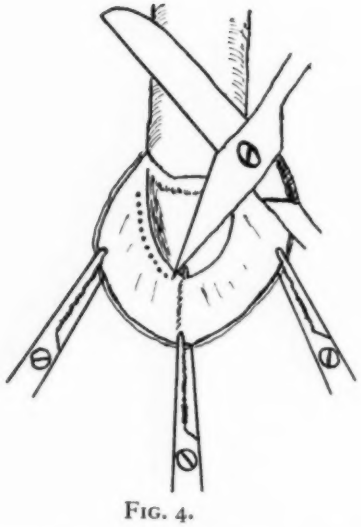

FIG. 4.

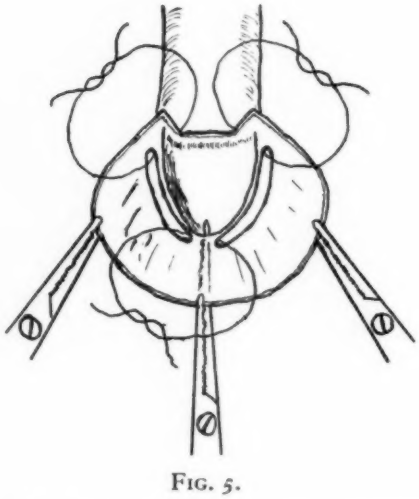

FIG. 5.

FIG. 6.

TECHNIQUE

A mosquito forceps is attached to each side of the tip of the foreskin, as shown in Figure 1. The point of a third forceps is introduced between the foreskin and the glans; by opening the forceps and rotating it on its longitudinal axis the adherent mucosa is separated, as shown also in Figure 1. Then two incisions, a dorsal slit and a lateral incision up to the dorsal arteries, dotted line in Figure 2, are made with scissors. The tip of the frenum is now grasped by forceps and the foreskin laid open as shown in Figure 3. With a sharp point of the open scissors the mucosa and

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the overlying skin are punctured near the frenum at its junction with the glans; then an incision through the mucosa and the skin is made almost up to the dorsal artery on the same side, Figure 4. A like incision is then made on the opposite side. This leaves the foreskin attached at three points, each of which has skin, artery and mucosa; one of these is the frenum, Figure 5. These three bands of tissue are then firmly ligated with silk or linen as shown in Figure 5, and the foreskin excised distally leaving three tags of tissue which dry and separate with the ligatures in three or four days, Figure 6.

The slight plication of the skin and the mucosa which takes place at the site of the ligatures keeps the cut surface of the skin and the mucosa in perfect apposition. Before cutting the ligatures short it is well to retract the skin at the intervening portions and then to tie into the nearest ligature any aberrant bleeding point. In the Norwegian American Hospital, where this procedure is now being used by obstetricians and internes, considerably less postoperative hemorrhage has been noted.

This technique is adapted to obstetric practice but is serviceable in older patients.

The advantages of the operation are as follows: (1) no suturing used; (2) inexpensive ligature material, only a twenty inch strand of silk or linen; (3) few instruments, required; four mosquito forceps and a pair of scissors with one sharp and one dull point; (4) operation completed without assistance in three to five minutes; (5) hemostasis by vessel ligation; (6) excellent approximation of skin to mucosa with less danger of infection; (7) the ligatures need not be removed; they drop off with the dry tags of tissue in three or four days, and (8) office procedure with little fear of secondary hemorrhage.

SUMMARY

This illustrated paper describes a rapid technique for circumcision in infants. Only three or four mosquito forceps and a pair of scissors are used. Ligation of all arteries is done with linen, silk or catgut and the skin is approximated to the mucosa without the use of suturing.

REFERENCES

Bertwistle. A plea for standard technic of circumcision. *Lancet*, 1: 85, 1935.

Bettman. An exact technic for circumcision. *West. Jour. Surg.*, 41: 220, 1933.

Brodie. Office technic of circumcision of adult. *Medical Record*, 141: 534, 1935.

Canright. Simple operative procedure of circumcision. *China Med. Jour.*, 45: 152, 1931.

Paul. New technic of circumcision. *Jour. Ceylon Br. Brit. Med. Assn.*, 26: 45, 1929.

Sinkoe and Artega. Modern technique for better plastic results. *Urol. and Cutan. Rev.*, 32: 728, 1928.

McWhorter. Technic of local anesthesia in circumcision. *Surg. Clin.*, 4: 151, 1920.

Curtis. Bloodless new method. *Practitioner*, 97: 101, 1916.

Millstone. Bloodless, cosmetically perfect technique. *Med. Rec.*, 92: 680, 1917.

Twyman. Two V-flap, practical circumcision for children. *Jour. Missouri Med. Assn.*, 14: 59, 1917.

Christopher. Minor Surgery. Ed. 2. Phila., W. B. Saunders Co., 1935, p. 435.

Foote and Livingston. Principle and Practical Minor Surgery. Ed. 6, Appleton, New York, 1929, p. 480.

PHYMOSIS AND PARAPHYMOSIS; CIRCUMCISION; DORSAL SLIT; CONSTRICTION OF MALE MEATUS

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PHYMOSIS AND PARAPHYMOSIS

PHYMOSIS is a constriction of the male meatus in which the prepuce can not readily be retracted back over the glans penis. Mild phymosis rarely gives trouble and the individual may not seek correction unless for hygienic reasons. Marked phymosis or one in which the prepuce cannot be retracted is more likely to present complications such as retained prepucial secretion, balanitis, benign or specific ulcers, herpes, papillomata, etc.

Treatment. The treatment of phymosis depends upon the character and severity of the complications present. Phymosis uncomplicated by infection is best treated by circumcision. Even in the presence of papillomata or simple balanitis circumcision may be done. In removing the prepuce papillomata should be removed also if they are in the area to be removed and may be either fulgurated or cut off at the base if they are in the area not to be removed.

Paraphymosis. Upon forcible retraction of a marked phymosis, and in some infections or in case of trauma in the presence of a normally retracted prepuce, paraphymosis may result.

Treatment. A simple method often successful in reducing paraphymosis is pressure over the swollen part by wrapping a towel or cloth around the penis and grasping it in the hand. Firm pressure usually will reduce the edema sufficiently to allow the constriction to be pulled back over the glans. Occasionally it is necessary to divide the constricting bands by incision back of the glans. Novocain one per cent is injected and the bands divided. Later circumcision is advisable.

CIRCUMCISION

Circumcision is carried out under novocain anesthesia in all except young children.

Technique. One per cent novocain solution is injected into the subcutaneous area about one-half to two-thirds the way from the glans to the base of the penis. By making a very quick puncture at the first site of injection and injecting ahead of the needle, the injection of novocain can be painlessly done. Other injections are made to complete the circle around the penis always introducing the needle into an area already anesthetized by a previous injection. Another circle of anesthesia is made in a similar manner just back of the corona. When the prepuce cannot be retracted several punctures may be necessary in the skin above the glans to allow an incision in the edge of the prepuce to permit its retraction. After anesthesia is complete the prepuce is drawn forward over the glans and a long straight clamp is applied at an exact point on the skin which is just back of the corona when the prepuce is not drawn forward. The inner part of the prepuce is also drawn tightly through this clamp taking care not to include the glans. The distal portion is cut off with a knife and the clamp removed. If the clamp has been properly applied the removal of more tissue will not be required. If necessary to trim away more tissue this may be done with scissors. The mucous membrane should be left about ¼ to ½ inch back of the corona. All bleeding vessels are caught and tied with fine catgut. It is important to tie all vessels and even oozing points. The edges of the skin and mucous membrane are then sutured together using a fine 00, ten to twenty day chromic catgut in a continuous suture. The

stitches are placed close to each other and care is taken not to draw the edges too tightly together. Since there is usually more

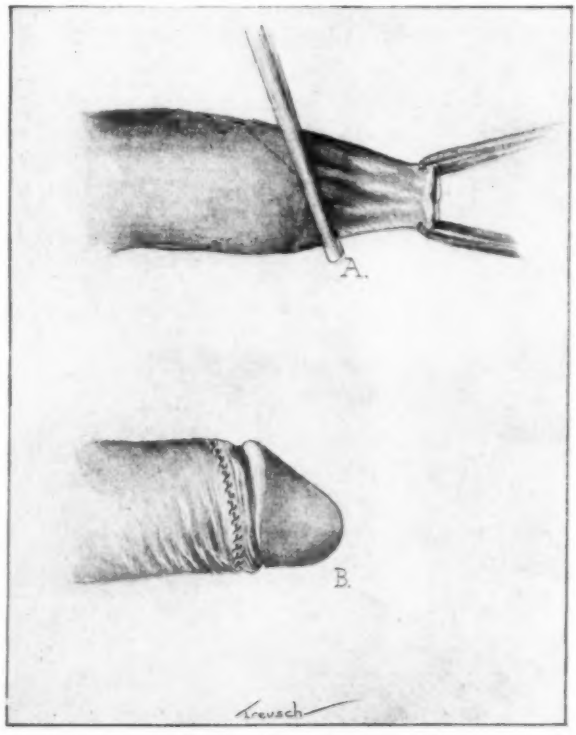

Fig. 1. Circumcision: A, clamp in place before removal of prepuce; B, after suture.

skin than mucous membrane it is important to measure the unsutured part from time to time so as to make the skin and mucous membrane come out even, at times taking the stiches further apart in the skin to make up for this difference. Experience has shown that there are less pain and painful erections after suturing in this manner than after the usual interrupted suture. The cosmetic result afforded is better and healing is prompt. A creamy paste of bismuth salicylate in mineral oil is applied and held in place with a bandage which is replaced in three days. The patient should exercise care not to wet the bandage. Usually the dressing is finally removed in a week or ten days. Tendency to infection or other untoward results have not been noted in over twenty years use of this technique.

DORSAL SLIT

In the event of a phymosis complicated by chancroidal or other infection severe enough to make circumcision not advisable a dorsal slit (Fig. 2) should be done to facilitate treatment of the infection. This

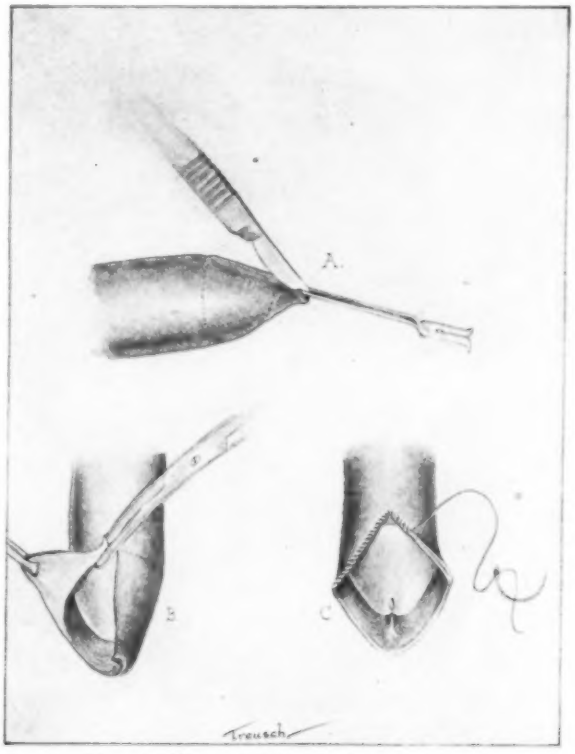

Fig. 2. Dorsal slit; A, incision through prepuce over grooved director; B, trimming away flap on each side; C, suture with continuous suture.

is done under novocain one per cent injected along the prepuce and down to the undersurface of the prepuce. A grooved director as a guide allows the incision to be made without danger of injury to the glans penis. The incision is made on the dorsal side and extended back behind the corona. Removal of a flap on each side at this time makes treatment easier and also facilitates or makes unnecessary circumcision later. The edges should be fulgurated in the presence of a chancroidal or other infection, otherwise the edges are sutured with interrupted or continuous stitches. After the infection has cleared circumcision should be done.

CONSTRICTION OF THE MALE MEATUS

A narrow meatus is the cause of many disorders of the urethra and prostate. Non-specific urethrititis, irritation in the

deep urethra, disorders of the sexual function, prolonged gonorrheal infection, and other complaints are frequently caused by a small meatus. When it is 26 F. or less meatotomy should be done.

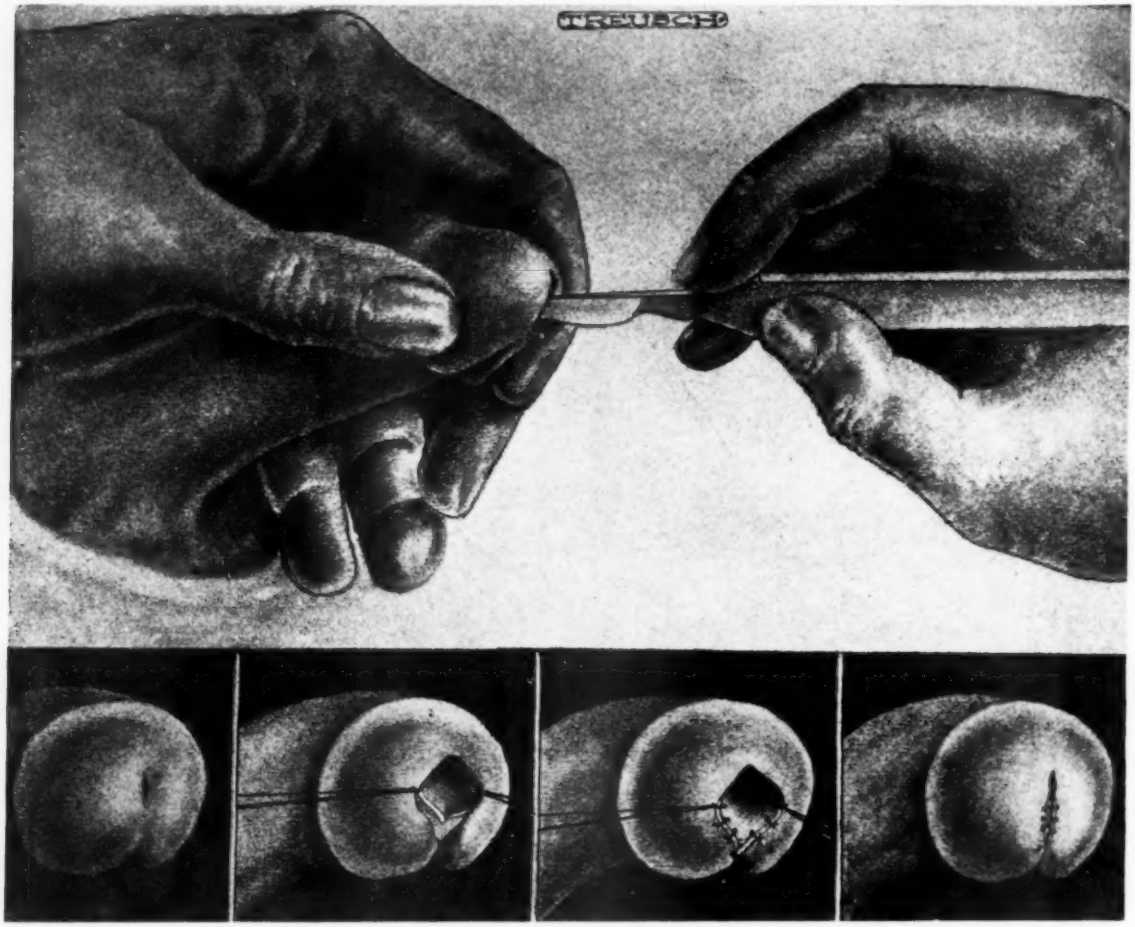

FIG. 3. Meatotomy; inserts show method of closing mucous membrane to skin using uncut sutures as retractors to facilitate introduction of lower stitches. The meatus is first infiltrated with novocain. Subsequent sounding is not necessary to prevent narrowing of the meatus in healing. The patient applies antiseptic solution twice daily for a week. (Ballenger et al. *Am. Jour. Surg.*, 8: 37–38, 1930.)

Technique. Anesthesia is obtained by hypodermic injection of one per cent solution of novocain into the lower edge of the meatus. Bleeding from the incised area is lessened by adding one drop of adrenalin chloride to the novocain solution. The meatus is opened to a 32 F. bulb. Using a fine 00 plain catgut the edge of the mucous membrane is then sutured to the skin edge on each side. It is not necessary to pass sounds to prevent subsequent narrowing of the meatus from cicatricial contraction. Taking the stitch in the lower part of the wound is greatly facilitated by leaving the ends of the side sutures long and using them as retractors to pull up the mucous membrane. Usually five stitches are required. In the event that it is desirable or necessary to cut upward instead of downward it is better to cauterize the edges of the wound with Monsel's solution as the sutures are not as easily placed on the upper part of the glans. Meatotomy with sutures to control hemorrhage and hasten healing gives a better cosmetic result than meatotomy as ordinarily done.

SUMMARY

While these affections usually are of minor importance, at times they may produce very serious complications. Individ-

uals in need of circumcision undoubtedly are more likely to contract syphilis and chancroidal infection than are the circumcised. Cancer of the penis is practically never seen except in men who are in need of circumcision and especially is it likely to arise when the foreskin is adherent to the glans penis.

Phymosis which develops secondarily to chancroidal infection may result in extensive destruction of the penis because of the difficulty in applying treatment.

The average doctor does not regard a small meatus as a matter of much concern. Yet it is often the unsuspected cause of non-specific urethritis, irritation of the deep urethra, disorders of the sexual function, prolonged gonorrheal infection, and other complaints.

Meatotomy with sutures to control hemorrhage and hasten healing gives better results than meatotomy as ordinarily done.

URETHRAL CARUNCLE*

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URETHRAL caruncle or vascular tumor of the meatus is the most common neoplasm of the urethra and was first described by Samuel Sharp in 1750, who said, "Small excrescences may occasion violent disorders in so tender an organ as the urethra." It is known by various other terms such as granuloma, papilloma, angioma and irritable caruncle.

ANATOMY

The growth practically always appears on the lower half of the meatus, is florid or dusky red in color, and is attached to the urethral margin by either a pedicle or a broad base which may extend into the canal. The appearance varies from flat and rugose and slightly elevated to a narrow tumor with a pedicle and a sharp crenated edge, standing out from the urethra and compressed by the nymphae. It is usually single, but occasionally there may be two or more.

HISTOLOGY

It is essentially a vascular growth and Skene, who made a special study of urethral neoplasms, applied the term papillary polypoid angioma and described it as a "bunch of dilated capillaries set in moderately dense stroma of connective tissue, covered with mucous membrane which has the usual pavement epithelium." The presence of any unusual number of nerve fibres or unusual arrangement of nerve endings has not been satisfactorily demonstrated although many believe they are well supplied with nerve tissue which accounts in some measure for their extreme sensitiveness.

ETIOLOGY

The exact cause is not known. It may occur at any age. It is most common just before, during or immediately after the menopause and it is more frequently seen in multiparae. In young women gonorrheal urethritis is thought to be a causative factor, as is inflammation of Skene's ducts. In older women chronic cystitis, cystocele and urethrocele are thought to cause the condition.

DIAGNOSIS

The diagnosis is usually made by inspection or examination and is obvious. Occasionally the condition is so sensitive that complete examination is not possible and this in itself is a point in favor of the presence of a caruncle.

Differential Diagnosis. Urethral caruncle must be distinguished from several conditions found in this region, although the differentiation is usually not very difficult. Urethral polypi which are usually much less sensitive and most often are attached higher in the urethra may at times be confused with caruncle. Prolapse of the urethra is another condition which occurs in this region, but the principal point of difference is that the prolapse involves the entire circumference of the meatus while the caruncle is most always on the lower half and a small part of that. Inflammation of Skene's ducts usually does not cause painful micturition which is an almost constant symptom of caruncle. Also, the gland openings can usually be seen and pus may be expressed from them. Cancer at this point is very rare, but patho-

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logical examination of the excised tumor will assure the diagnosis and proper follow-up treatment may be instituted without any harm having been done either by trauma or delay.

CLINICAL HISTORY

The principal symptom is pain. It may take the form of painful micturition, either slight or severe. Dyspareunia is a common symptom, with consequent upset of the nervous system. Pressure on walking or sitting and especially pressure from clothing or sanitary pads are frequent complaints. Occasionally, retention of urine for long periods is noted and this is brought on gradually by the individual in her attempt to avoid painful micturition. Hemorrhages may occur when the vessels are near the surface and these may vary from slight staining to bleeding of alarming proportions, especially when they are recurrent. In extreme cases the constant pain and discomfort may cause irritableness, despondency, loss of appetite, loss of weight, loss of sleep and sometimes leads to severe nervous upsets, the cause of which is many times completely overlooked. Frequency of micturition without pain is found in the occasional case but to be without pain is very rare.

TREATMENT

Various forms of treatment have been used with varied success. One author advocates the removal of the tumor with a scissors and suturing the base. He contends that removal by cautery is unreliable, causes unnecessary destruction of tissue and promotes the formation of uncontrollable scar tissue. Another maintains that the procedure should be entirely surgical, with free excision of the entire base and the wound closed with sutures. Still another is of the opinion that simple excision is followed by a large percentage of recurrences and that removal by a small tip cautery is followed by the largest proportion of permanent cures. Kelly advises complete extirpation, preferably by electrodessication or electrocoagulation of the base. The treatment we advise and have found to be uniformly successful in uncomplicated cases is a combination of both surgical excision and the cautery.

Technique. Under surgical anesthesia a semicircular incision is made along the margin of the meatus about the tumor. We make sure that this incision is wide enough to include the base of the tumor and deep enough to include the full thickness of the mucous membrane. The growth is then excised and the base is coagulated with a fine tip cautery. Very rarely are sutures used in the entire procedure, although they may be used at the angles for approximation of the cut edges. Care must be exercised in the use of the cautery in order to avoid injuring the surface epithelium thereby causing a troublesome scar. If the cautery is confined to the base of the tumor which is below the mucous membrane, the surface pavement epithelium will heal uneventfully and recurrence is rare.

PROGNOSIS

The prognosis is not always hopeful, especially in recurrent cases. Many of these tumors are very stubborn and reformation is likely to occur with the consequent deformity of the orifice by repeated partial operations. In primary cases, with complete excision and cauterization of the base the cure is complete in practically every case in our experience.

SUMMARY

First, I would again call attention to the frequency of the condition, especially in women of middle age or older;

Secondly, to the necessity for inspection and examination of patients who complain of urinary symptoms; and

Thirdly, to the importance of surgical treatment in the beginning, as the chance of cure with palliative treatment is slight.

TREATMENT OF SPECIFIC URETHRITIS—NEW MODALITY*

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I AM presenting, as a preliminary report, the results obtained by treating a number of cases of chronic and acute specific urethritis, both with and without joint involvement, with large doses of the gonorrheal vaccine supplied by the Department of Health, New York City, regulated according to individual reaction, in concentrations of one to five billion gonococci per cubic centimeter. I believe that the beneficial end-result is due to a sufficient dose to produce a bacterial protein shock, which is probably specific and not necessarily due to the specific organisms. The city vaccine contains seven strains (Torey) of organisms and hence seven types of bacterial protein, and the massive dosage of these varying proteins or the combination of the organisms and their proteins may account for the more satisfactory results as opposed to those obtained by non-specific proteins such as milk or proprietary preparations.

How immunity is produced by the vaccine is a disputed question. It has been known for some time that the histiocytic elements in the skin can be stimulated both by specific and non-specific proteins. In the vaccine we may have a soluble specific protein that is directly and to all appearances easily engulfed by the histiocytic cells. The result is the formation of a specific antibody which is available to battle the infection produced by the gonococcus, regardless of the part of the body in which it may localize. This specific antibody accumulation is amply demonstrated by the complement fixation test for gonorrhea. Generally, in the first stages of the infection, the complement fixation reaction may be negative but after the disease has run its course, either treated or untreated, the complement fixation test may be positive.

Up to the present time, no literature or data are available on the treatment of gonorrhea by massive dosage of gonococcus vaccine. The vaccine is distributed in a concentration of five billion gonococci per cubic centimeter by demand, and the dosage is determined by the physician making the request.

About five years ago, the use of gonococcus vaccine intradermally in concentrations of 250,000,000 per c.c. in cases of specific urethritis was started in the Genito-Urinary Clinic at the Harlem Hospital. The initial dose was 0.10 c.c., increasing to 0.50 c.c., never any higher. The results were negligible. At the present time, concentrations of 250,000,000 gonococci per c.c. are used intravenously at this clinic for the treatment of acute epididymitis; 0.125 c.c. are given as an initial dose, and is followed by 0.25 and 0.50 respectively at weekly intervals. They report that within from one to three hours after the injection of the vaccine the patient has chills, temperature and general malaise. The epididymitis subsides satisfactorily by this method of treatment.

In the out-patient department of our clinic at Gouveneur Hospital, many chronic discharging patients had been treated by the recognized methods for many months without success. Several of these cases were given an initial dose of 0.2 c.c. of the five billion concentration of the City gonorrheal vaccine subcutaneously in alternate thighs. Each injection was increased by sufficient dosage twice each week until a considerable reaction accompanied by chills and fever was obtained. It was noted

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that the initial dose of 0.2 c.c. produced erythematous areas which varied in extent with each individual, but generally speaking, when the dosage had reached 1 c.c. and above, there was no increase of the size of the area of erythema, although there seemed to be an involvement of the deeper structures, judging from increased tenseness. This was further evidenced by heat, tenderness, and a red blotching discoloration at the site of injection.

These larger doses proved to be somewhat disabling for a period of one to four days. The initial reaction occurred from three to six hours after the injection. The patient complained of hypersensitivity to extraneous objects such as clothing, and an intense itching of the skin area involved. Immediately upon getting the "major shock" manifested by temperature from 102°–104°; headache, chills and general malaise, the patient noted cessation of the discharge twelve to twenty-four hours later. It may be that the temperature produced attenuates the gonococcus in a manner similar to the various forms of heat therapy now in vogue. The urine became clear in both glasses, with only an occasional shred in the first one. After the discharge ceased, there was no continuation of the morning drop. It has been a question in my mind whether the long continued morning drop might not be the result of the frequent self-administered instillations, giving rise to a chemical and secondary urethritis. In conjunction with this treatment, we have prescribed routinely acriflavine 1:5000 dilution as a hand injection for the patient. No other medication was used.

DISCUSSION

Twenty-eight cases of gonorrheal urethritis are presented which were treated by means of varying doses of gonorrheal vaccine. This procedure was instituted in an effort to cure the large number of chronic discharging cases of long standing which did not respond to the ordinary methods of treatment. In this group (Table 1), however, are included several cases of specific urethritis who came under our observation at the end of the usual incubation period. These acute cases demonstrate the effectiveness of the vaccine therapy early in the course of the disease. Because of the types of patients treated and because of the long-standing practice of prescribing some type of medication for the urethra, it was thought advisable, merely for uniformity of results, that the patient be given a bland and rather innocuous solution for self-instillation. This was neutral acriflavine in dilution of 1:5000 for use once each day. This proved effective in preventing the patient from obtaining more drastic medication elsewhere. For purposes of comparison and control, another group of cases treated with various instillations are included in Table II, and in Table III a group treated with vaccine alone.

It is my belief that the rather startling results obtained in this series were due to the various bacterial proteins found in the vaccine and not to the specific organisms. I have no way of proving this statement.

The largest single injection of vaccine given in this series, which caused the "major shock" was 11 c.c., and this patient (No. 10 in the table) received a total of 64.5 c.c of vaccine. Prior to the institution of vaccine therapy, the patient had lost forty-five pounds in weight, and being of slender build, he offered a pathetic picture. The chronicity of this case had become so desperate and the discharge prior to the vaccine shock so profuse that it was thought that a stricture of the urethra had developed but careful calibration of the canal revealed no constriction of the urethra. Shortly after the discharge ceased at the end of seventy-seven days, he gained twenty-seven pounds. The urine became perfectly clear with only an occasional shred, and there has been no recurrence of the previous manifestations. It is striking that in all of these 28 cases, once having secured a true bacterial protein shock, the annoying and chronic morning discharge which had persisted under the ordinary

TABLE I

Case Number.....	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Time between discharge and exposure.....	7 days	14 days	?	10 days	0	7 days	10 days	7 days	7 days	7 days	10 days	7 days	7 days	?
Previous attacks of gonorrhea	No	No	4 times	No	No	3 times	No	1 time	No	No	1 time	No	No	1 time (20 yrs.)
Smear.....	Positive	Positive	Positive	Positive	See remarks	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive
Number of days of discharge before 1st visit.....	6 days	10 days	?	31 days	0	4 days	7 days	42 days	40 days	33 days	21 days	21 days	1 day	35 days
Initial dose of vaccine.....	0.2 cc	0.2 cc	0.2 cc	1.0 cc	0.2 cc	0.2 cc	2.0 cc	0.5 cc.	0.2 cc	2.0 cc	0.2 cc	0.2 cc	0.2 cc	1.0 cc
Reaction: o-None x-Slight xxx-Moderate xxxx-Severe (Major)	0.2-x 1.0-x 2.0-xxx	0.2-x 1.0-xxxx 3.0-xxx	0.2-0 1.0-x 2.0-x 2.5-x 3.5-x 4.5-x 5.5-x 7.0-xx 8.0-xxx	1.0-x 1.5-x 2.5-x 3.5-x 4.0-x 6.0-xxx	0.2-0 2.0-x 3.0-x 4.0-xxx	0.2-xx 1.0-xxx	2.0-0 3.0-0 4.0-x 5.0-x 6.0-x 7.0-xxx	0.5-0 1.0-x 1.5-x 2.0-x 2.0-x 3.0-x 3.5-x 4.0-x 4.5-x 5.0-xx 5.5-xx 6.0-xxx 7.0-xxx	0.2-x 1.0-x 2.0-xx 3.0-xxx 4.0-xxx 4.5-xxx	2.0-0 2.0-x 3.0-x 4.0-x 5.0-x 6.0-x 6.5-x 8.0-x 9.0-x 10.0-x 11.0-xxx	0.2-0 2.0-x 4.0-xxx 5.0-xxx	0.2-0 1.0-0 3.0-xxx 4.0-xxx	0.2-xx 1.0-xxx	1.0-0 2.0-x 4.0-xx 5.0-xx 6.0-xxx
Total amount of vaccine given before major shock	4.2 cc	4.2 cc	27.2 cc	17.5 cc	9.2 cc	1.2 cc	25.2 cc	51 cc	16.5 cc	64.5 cc	11.2 cc	8.2 cc	1.2 cc	18 cc
Time elapsing before discharge ceased after vaccine was given.....	9 days	7 days	42 days	14 days	22 days	5 days	24 days	56 days	7 days	44 days	10 days	10 days	6 days	3 days
Complement fixation.....	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Not taken	Positive
Recurrence of symptoms	No	Yes, see rem'ks.	No	No	No	No	No	No	Yes	No	No	No	No	No
Joint involvement..	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No
Acute epidymitis...	No	Yes	No	No	No	No	Yes	No	No	No	No	No	No	Yes
Time urine became clear.....		7th day	42nd day	14th day	25th day	5th day	24th day	56th day	24th day	44th day	27th day	25th day	36th day	35th day

TABLE I (*Continued*)

Case Number.....	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Number of days of the discharge.....	6 days	7 days	42 days	40 days	35 days	44 days	44 days	98 days	15 days	77 days	31 days	31 days	6 days	38 days
Disposition of case	Under observation	Discharged	Under observation	Discharged	Discharged	Discharged	Discharged	Discharged	Under observation	Discharged	Discharged	Discharged	Discharged	Discharged
Remarks.....	Received major shock with 2 cc vaccine	Pain in testicle relieved by calcium gluconate 10 per cent. Had inguinal swelling. Frei test negative. Had recurrent discharge which cleared after major shock of 3 cc vaccine.	Patient had intercourse several times during treatment.	Thick yellow chronic discharge treated with instillations and syringe by patient 30 days. Had knee and right shoulder involvement.	Smear on admission was doubtful. Positive 7 days after initial visit. Treated by ordinary methods 1st 20 days.	Severe reaction following 1 cc injection. (Herpes, chills, fever—104, in bed 4 days.) Also undergoing treatment for lues.	Treated Bellevue before admission for acute epidymitis. Treated here with calcium gluconate 10 per cent and instillations without benefit. Treated 33 days before vaccine therapy was started.	Had 42 days of treatment elsewhere mainly auto instillations. When seen discharge profuse, thick yellow. Joint involvement. Calcium gluconate 10 per cent.	With 3 cc temp. 102° general disability. 4 cc. major shock. No symptoms for 10 days. Then recurrent discharge cloudy urine, 4.5 cc vaccine produced major reaction. In bed 3 days. Temp. 104 discharge ceased. Admits use of pepper and vinegar 10 days before.	1st 7 days ordinary methods without results. Discharge profuse, urine cloudy with shreds. After major shock discharge watery and ceased. Urine hazy then clear.	Here again discharge ceased before urine became clear. Major shock occurred with an additional 1 cc (2nd) and urine cleared.	Discharge ceased before urine cleared. Urine remained hazy for 11 days before clearing after last dose of vaccine.	Shock sufficient to stop discharge. Only 1.2 cc vaccine.	Patient to clinic after 5 weeks of discharge. After 6 cc vaccine received typical shock. Discharge disappeared as likewise did the epidymitis.

TABLE II

Case Number.....	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Time between discharge and exposure.....	7 days	10 days	4 days	7 days	3 days	7 days	3 days	9 days	?	10 days	7 days	3 days	?	7 days
Previous attacks of gonorrhea	No	No	Yes (12 yrs.)	No	No	No	No	No	No	No	Yes (3 yrs. ago)	No	No	No
Smear.....	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive
Number of days of discharge before 1st visit.....	7 days	10 days	4 days	18 days	3 days	10 days	3 days	21 days	5 days	6 days	?	3 days	21 days	14 days
Medication given for self instillation...	Acriflavine 1:5000	Acriflavine 1:5000	Acriflavine 1:5000	Acriflavine 1:5000	Acriflavine 1:5000	Protrogol —¼ per cent $KMNO_4$ —1:8000	Protrogol —¼ per cent	Protrogol —½ per cent	Protrogol —¼ per cent	Protrogol —¼ per cent	$KMNO_4$— 1:5000	Protrogol —¼ per cent	Protrogol —½ per cent	Acriflavine 1:5000
Total number of days with above treatment.....	36 days	202 days	90 days	50 days	112 days	240 days	150 days	60 days	216 days	147 days	105 days	40 days	108 days	41 days
Other treatments used	Argyrol 5 per cent —1st 15 days	Acriflavine	None	None	None	Argyrol 5 per cent	.....	None	Zinc sulphate— ¼ per cent	None	Corbus ferric filtrate	Corbus ferric filtrate	None	Argyrol per cent
Complement fixation	0	Positive	0	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive
Recurrence of symptoms	No	Yes (morning drop)	See remarks	Yes	Receiving cloudy urine	Receiving cloudy urine	No	See remarks	Yes discharge	No	No	No	See remarks	No
Joint involvement..	No	Back and lft. knee	No	No	No	No	No	No	No	No	No	No	No	No
Acute epidymitis...	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No
Time urine became clear	92nd day	Still hazy	90th day	50th day	46th day	Never cleared	170th day	Still hazy	222nd day	147th day	105th day	123d day	124th day	164th day
Number of days of the discharge....	60 days	202 days	90 days	50 days	30 days	240 days	150 days	81 days	221 days	147 days	105 days	43 days	144 days	55 days
Disposition of case	Under observ.	Still under treatment	Discharged	Discharged	Discharged	Left clinic address unknown	Under observ.	Under observ.	Under treatment.	Under treatment.	Under treatment.	Under treatment.	Under treatment.	Discharged.
Remarks.....	Lost 20 lbs. in wt. Still has A.M. drop.	Still has A.M. discharge and drop. Has had a series of prostatic massages and bladder irrigations.	Had swelling of prepuce and shaft of penis. Dorsal slit necessary.	Epididymitis 30 days after treatment started. Calcium gluconate 10 per cent. Urine became clear 50 days after treatment.	Persistent discharge, hazy urine.	Persistent discharge after 40 days of treatment. Urine has not cleared. No stricture present.	Persistent A.M. drop.	Still has A.M. drop hazy. Epididymitis 10 days following treatment.	Discharge 260 days. Persistent A.M. drop Prostatic massage.	Slight discharge after 147 days of treatment. Prostate enlarged and boggy, inumerable pus cells.	Prostatic massages to clear urine. Inumerable pus cells.	Discharge cleared in 40 days. Epididymitis 30 days after treatment was started.	Prostatic massages for discharge 36 days after first cessation.	Profuse discharge.

methods has not been found, with a single exception.

Patient No. 8 had one of the most persistent and devastating cases of gonorrhea that has come under my observation. He had had a discharge for forty-two days before coming to the clinic. He was pale, decidedly underweight, and suffering from multiple joint pains. There was an almost continuous flow of thick yellow discharge. He received his "major shock" after a dosage of 7 c.c. of vaccine or a total of 51 c.c. He has been followed for approximately three months since and there has been no recurrence of the joint pain or discharge. The urine is clear.

Cases Nos. 2 and 7 had acute epididymitis when they applied to the clinic for treatment. The only case of acute epididymitis which developed in any patient while under treatment was No. 14, which can be attributed directly to the over-zealous administration of a remedy purchased outside the clinic.

The one case of recurrent discharge is patient No. 9, and he received, before definite improvement resulted, three "major protein shocks"; the first with 3 c.c., the second with 4 c.c., and the third with 4.5 c.c. of vaccine. The discharge ceased after the 3 c.c. injection, but the urine remained cloudy. The urine became clear after the 4.5 c.c. injection, and the thin recurrent discharge disappeared. Questioning revealed that in the interum between the first cessation of the discharge and the last, he had partaken of a rather large amount of spiced vinegar.

It will be noted that those patients who came in at the end of the incubation period with discharge required comparatively small doses of vaccine to secure the "major shock," and that in but one of these cases has there been a recurrence of discharge. In cases Nos. 1, 2, 6, and 13 the average duration of discharge after vaccine therapy was 7.7 days; and in case No. 6, it was only four days. The economic factor here is of importance, at least to the patient.

Another thing which is revealed by this series of cases is that, usually, the discharge stops before the urine clears, although in some cases the urine and discharge stop simultaneously. In those cases where the urine remains hazy and the discharge has ceased, a second prophylactic dose of vaccine is necessary, which may be the same or slightly larger than the initial one used to secure the "major shock." The urine usually clears after the second shock.

The quantity of vaccine tolerated before the bacterial protein shock occurs, varies with each patient. Further experiments have shown that having once received the shock with a given dose, if it is necessary to repeat the injection, a second shock is invariably experienced by injection of the same amount of vaccine, or an increase in dosage limited to only tenths of a cubic centimeter. In the acute type of case, far smaller dosage is required to secure the "major shock" than in the latter stages of the disease. I believe that our previous failure with gonorrheal vaccine has been largely due to our timidity in giving adequate dosages. My experience leads me to believe that similar results may be obtained by the intravenous administration of the vaccine if the amount is increased sufficiently to produce a maximum reaction.

In no case have we experienced any complications such as abscesses at the site of the injection. It has been our practice to give the injection in alternate thighs, and it is less disabling if injected in the mid-anterior region of the thigh. On one or two occasions, the reaction has been severe enough to cause marked swelling of the thigh.

When the "major shock" is experienced, it is accompanied by two or three days of more or less disability. However, despite the reaction, these patients appreciate the disappearance of the profuse chronic discharge and subsidence of symptoms which in some instances have persisted for ninety days, as well as their improved physical condition. They feel that any reaction and disability is far outweighed by the final result.

I believe that in the treatment of gonorrhea we must never lose sight of the fact

TABLE III

Case No.	633993	68998	632038	612767	587832	63848	68543	632862	632768	630637	66736	25546	21881	37288
Time between discharge and exposure	10 days	10 days	7 days	10 days	3 weeks	1 week	10 days	7 days	10 days	7 days	14 days	7 days	7 days	10 days
Previous attack of gonorrhea.	No	Yes—3 mo. ago	No	No	No	No	No	No	1 time	1 time—2 mo. ago	4 times	2 times	No	No
Smear	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive
Number days of discharge before 1st visit	2 days	?	1 day	3 days	3 days	?	3 weeks	4 weeks	4 months	7 days	10 days	7 days	7 days	3 weeks
Initial dose of vaccine	0.2 cc	0.2 cc	0.2 cc	0.2 cc	0.2 cc	0.2 cc	0.1 cc	0.2 cc	0.2 cc	0.2 cc	0.2 cc	0.2 cc	0.2 cc	0.2 cc
Reaction: o—None x—Slight xxx—Moderate xxxx—Major	0.2 cc-x 1.0 cc-xx 1.0 cc-xxx 1.5 cc-xxxx	0.2 cc-xxxx 1.0 cc-xxxx 2.0 cc-xxxx 4.0 cc-xx 3.5 cc-xx 3.5 cc-x 3.6 cc-x	0.2 cc-x 1.0 cc-xx 2.0 cc-xxxx	0.2 cc-x 1.0 cc-x 2.0 cc-xx 3.0 cc-xxxx	0.2 cc-x 1.0 cc-xxxx 1.0 cc-xx 1.5 cc-xxx	0.2 cc-o 1.0 cc-xxxx	1.0 cc-o 2.0 cc-xx 3.0 cc-xxxx	0.2 cc-xxx 1.0 cc-xxxx	0.2 cc-o 1.0 cc-xx 2.0 cc-xxxx	0.2 cc-xx 1.0 cc-xxxx	0.2 cc-xx 1.0 cc-xxx 2.0 cc-xxxx	0.2 cc-x 1.0 cc-x 2.0 cc-xxxx	0.2 cc-x 1.0 cc-xx 2.0 cc-xxxx	0.2 cc-o 1.0 cc-x 2.0 cc-xxx 2.0 cc-xxxx
Total amount of vaccine given	3.7 cc	20.8 cc	3.2 cc	6.2 cc	3.7 cc	1.2 cc	6.0 cc	1.2 cc	3.2 cc	1.2 cc	3.2 cc	3.2 cc	3.2 cc	5.2 cc
Total amount of vaccine given before major shock	3.7 cc	3.2 cc	3.2 cc	6.2 cc	1.2 cc	1.2 cc	6.0 cc	1.2 cc	3.2 cc	1.2 cc	3.2 cc	3.2 cc	3.2 cc	5.2 cc
Number of days discharge ceased after vaccine given	6 days	172 days	10 days	14 days	12 days	3 days	12 days	3 days	14 days	12 days	12 days	10 days	5 days	5 days
Complement fixation	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive
Recurrence of symptoms.	No	Yes—see remarks	No	No	No	No	No	No	No	No	No	No	No	No
Joint involvement	No	Yes	No	No	No	No	No	No	No	No	No	No	No	No
Acute epidymitis	No	No	No	No	No	No	No	See remarks	No	No	No	No	No	See remarks
Time urine became clear	12th day	7th day	2nd day	9th day	14th day	5th day	5th day	5th day	14th day	12th day	12th day	18th day	16th day	5th day
Disposition of case	Discharged no symptoms	Improved	Discharged no symptoms	Discharged no symptoms	Discharged no symptoms	Discharged no symptoms	Discharged no symptoms	Under observation	Discharged no symptoms	Discharged no symptoms	Discharged no symptoms	Under observation	Discharged no symptoms	Discharged no symptoms
Remarks	Peri-urethral abscess on admission which was opened 8	Patient first seen May 26th. Had had discharge for 3 months which he		Discharge with burning 2 weeks before coming in. Major shock ac-	O of santol wood for burning on urination. Sod. Bicarb. 1 tsp. b.i.d.	Acute prostatis when first seen; rapidly subsided under vaccine		Purulent discharge on admission; pain in left testicle. Swelling of the			Urine clear and no discharge after the 12th day	No symptoms		Had swollen left testicle which subsided after the "major shock."

day later. No discharge after 15 days from urethra or abscess.	treated himself. Walked with cane. Joint involvement right foot, hands, neck. Right great toe that he is unable to wear shoe. Following 2nd injection swelling became so reduced that he was able to wear shoe 30 days after instigating treatment. Swelling of left hand remained unchanged. The 4 cc dose of vaccine was followed by temperature (103.2° F). chills, herpes. 24 hrs. later there was marked improvement of both foot and hand. Three months later patient walks without cane and is entirely free from pain.					
		companied by chills, fever. In bed 5 days. Slight discharge reoccurs after partaking seasoned food. This with last 1.5 cc dose of vaccine.				
			therapy. Sitz baths. Home conditions prevented self treatment.			
				right inguinal region which has subsided.		

that it is a general systemic disease, just as is any bacterial invading disease. When treating gonorrhea, we are apt to focus our attention on the urethra, and lose sight of the fact that we are treating a general condition.

CONCLUSIONS

1. There are presented 28 cases of specific urethritis effectively treated with massive doses of gonorrheal vaccine.

2. The evidence seems to show that each patient builds up an antibody immunity during the course of his disease.

3. Consequently, patients longer in the course of their disease require larger doses of the vaccine to secure the described bacterial protein shock.

4. Patients seen at the close of their incubation period require far smaller doses to secure a satisfactory result.

5. The author believes that the results are obtained from the bacterial protein and their antibodies rather than from the microorganisms.

6. The success of this treatment depends upon the judgment of the physician, whose experience is gained by the observation of a large number of patients.

REFERENCES

1. Barringer, E. D. The treatment of gonorrhea in the female. *J. A. M. A.*, 103: 1825–1828, 1934.
2. Cummings, R. E. and Burhan, R. A. Experiences with gonococcus filtrate. (Corbus Ferry) and other forms of intradermal therapy. *J. A. M. A.*, 104: 181–186, 1935.
3. Brunet, M. M. and Levin, B. S. *Am. Jour. Obst. and Gynec.*, 28: 501–510, 1934.
4. Gernin, J. T. Bacteriophagic lysins. *Urolog. and Cutan. Rev.*, 38: 795–798, 1934.
5. Rahlives, G. G. Gonococcus vaccine. *Med. Welt.*, 8: 1228–1231, 1934.
6. Sommer, S. Intracutaneous administration of living vaccine in women. *Monatschr. f. Geburtsch. u. Gynäk.*, 97: 339–348, 1934.
7. Schultz, W. S. Living vaccine. *Central f. Gynäk.*, 59: 306–310, 1935.

DIAGNOSIS AND TREATMENT OF STRICTURE OF MALE URETHRA*

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THERE has been a notable decrease in the incidence and severity of stricture of the urethra in the past few decades, particularly of the inflammatory type. On the other hand, owing to the hazards of our more complex existence, traumatic strictures have increased. The grave sequels seen in former years have been reduced, due to a better knowledge of urethritis and injuries of the urethra, improved diagnostic measures and more conservative treatment. However, it is not uncommon in practice and the more severe types are still comparatively frequent in our municipal clinics and hospitals. With improved prophylactic measures and the routine roentgenographic delineation of the urethra and its adnexa, further progress is inevitable.

Stricture of the urethra is an abnormal narrowing or loss of dilatability of the urethral lumen. It may occur in either sex, but is more serious in the male. It is difficult to say just what constitutes an atypical reduction in the caliber of the canal, for the normal areas of narrowing may be markedly accentuated without causing urinary disturbance unless infection takes place, a small calculus becomes lodged in the urethra, or the introduction of large sized instruments is necessary (Fig. 1).

They may be temporary or permanent, and the accepted classification is as follows:

Spasmodic;
Congenital;
Acquired { Traumatic / Inflammatory.

For the diagnosis and treatment of the varied types of stricture, urethrocystography, the roentgenographic delineation of the urethra and bladder with the use of an innocuous contrast medium is invaluable, either used alone or as a complement to other methods. It gives a visual demonstration of chronic pathological lesions of the urethra and its adnexa. Temporary or permanent narrowings and their differentiation from other lesions can be defined with clearness; while instrumental investigations serve to locate and determine the extent, number and size of the areas of constriction, they fail to give the information as accurately and completely as urethrocystography. Cystourethroscopic examination shows surface changes in the urethra, but urethrocystography also delineates subsurface changes of the urethra, glandular adnexa and the bladder. This simple and practical diagnostic procedure has been described in a previous communication.

Spasmodic stricture is due to spasm of the investing muscles rather than organic change. It may be caused by acute or chronic inflammation of the prostatic urethra, nervousness of the patient or rough instrumentation (Fig. 2). It is often associated with inflammatory stricture, particularly when the prostatic portion is affected. It may be diagnosed by instrumental methods similar to those used to determine other types, or by urethrocystography. The treatment is based on removal of the underlying cause. Palliative measures consist of local application of heat, sedatives and anti-spasmodics and catheterization if necessary, for the prevention of an overdistended bladder.

Congenital constriction at the meatus is more frequent than any other type. It is

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seen in individuals with otherwise normal urethras or may be associated with congenital abnormalities such as hypospadias,

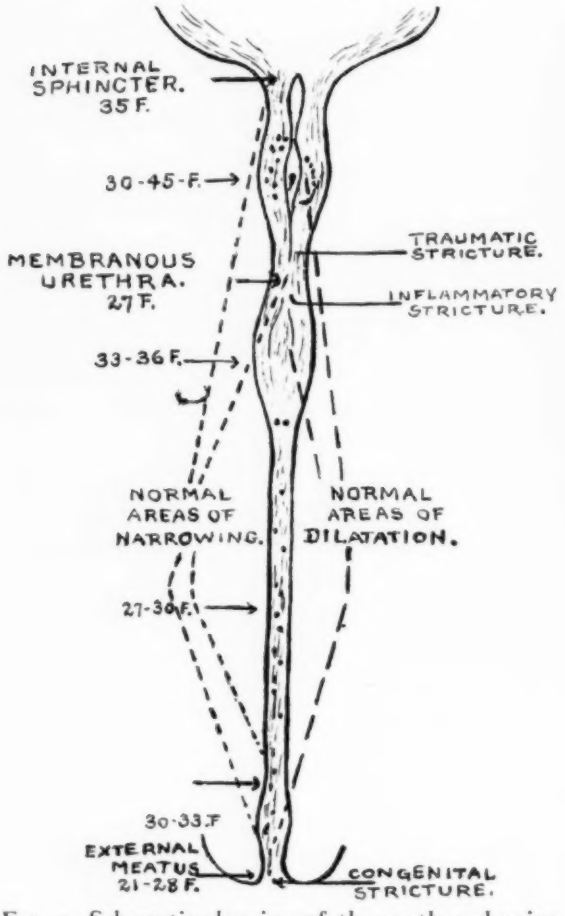

Fig. 1. Schematic drawing of the urethra showing normal points of narrowing and most frequent sites of constriction.

etc. The extent and depth of the meatal stricture is determined by passing a blunt pointed probe, with its tip on the urethral floor, beyond the constricted zone, noting any irregularities with the tip of the instrument as it is withdrawn in a vertical position. Dilatation is of no avail; meatotomy by simple incision or by the method of Ballenger and Elder gives permanent relief.

Congenital stricture of the urethra is infrequent. It occurs as a fold of mucous membrane between the meatus and bulbous portion (Fig. 3), or as a valvular or band-like type in the prostatic urethra. The diagnosis is best made with the cystourethroscope. The more routine use of cystourethroscopy in recent years, has served to demonstrate a relatively increased number of these lesions. Treatment consists of endoscopic destruction of the bands either

Fig. 2. Spasmodic stricture at bulbomembranous junction; urethrocystogram shows no evidence of abnormality.

with the Bugbee or the author's type of electrode.

Obstruction due to the injudicious use of some type of corroding chemical or antiseptic is comparatively rare. The entire canal is never involved, normal areas of mucosa alternate with those of scar tissue. No instrumentation is attempted during the active stage; sedative and demulcent injections are administered until the reaction subsides. The extent of the injury may then be determined by instrumental and urethrocystographic examination. The further treatment is essentially the same as for injuries of the urethra.

Traumatic strictures are caused by an internal or external injury to the urethra. Constriction usually begins as soon as healing takes place with the early formation, at times, of dense cicatricial tissue. Complete occlusion is rare and only develops when there is an opening in the urethra proximal to the obstruction. Such occlusion is usually single as opposed to the

multiple type of inflammatory origin, and is most frequent in the membranous and bulbous portions of the urethra (Fig. 4). They may follow unskillful instrumentation with sounds, cystoscopes, etc., (Fig. 5) particularly when an anesthetic is used; or may develop after punch operations or transurethral resections where the caliber of the instrument is disproportionate to the size of the canal. In some of those patients with persistent urinary disturbance following instrumentation or transurethral resection for enlarged prostate, we have found bands of fibrous tissue extending between the lateral lobes or bridging the internal sphincter which either interfere with the egress of urine or serve to prolong the urinary disturbance unless promptly destroyed. A calculus may become pocketed behind the area of constriction and increase to such an enormous size as to cause complete obstruction. Two cases were seen and operated on my service at Gouverneur Hospital during the past year. External violence to the urethra from falling astride objects, bullet wounds or injuries to the pelvis may result in lacerations or complete rupture of the canal with the formation of subsequent scar tissue (Figs. 6 and 7).

Every traumatized urethra should be examined carefully, for any injury, slight or severe, may eventuate in a stricture without giving preliminary manifestation of urinary disturbance or obstruction. The site and extent of the constriction in relationship to the lumen of the canal is determined by instrumental and urethrocystographic examinations. Early diagnosis is essential and prolonged dilatation should be carried out to forestall, if possible, the formation of cicatricial tissue. If dilatation is unsuccessful, as it so frequently is in traumatic strictures, incision by internal or external urethrotomy or resection by the Cabot or McGowan methods should be performed.

Of the acquired types, inflammatory strictures are most common and usually due to gonorrhea. They may be large or small, and may or may not be permeable to whips or even filiforms. That these constrictions are not caused by the inflammatory process per se is shown that with

Fig. 3. Sketch of cystoscopic view of congenital stricture; a valvular fold in bulbous urethra.

the proper treatment of acute urethritis, there is a decreased tendency to the development of dense scar tissue; and is confirmed by the fact that in recent years, with earlier and milder remedial measures, there has been a distinct decrease in their number. They develop slowly, rarely before the first year following the initial infection, and may appear ten to twenty-five years later. The bulbous and particularly the bulbomembranous areas are far more prone to constriction than the pendulous portion, although any part of the canal may be affected (Figs. 8 and 9). Contraction takes place more slowly and to a lesser degree in the pendulous urethra than in the bulbomembranous region. Bar-like elevations or contractures of the vesical neck may occur as terminal cicatricial changes of hyperplasia of the glandular structures at the vesical lip, and clinically, may simulate hypertrophy of the prostate.

A large or small caliber stricture may exist for a considerable length of time

without causing characteristic symptoms. The diagnosis is based on what has been termed by Guyon as "urethral history" of

Fig. 4. Traumatic stricture; atresia of pendulous urethra.

the case. The history may reveal a previous chancre or chancroid, injury or attacks of acute or chronic urethritis. On inspection and palpation, there may be evidence of tuberculosis or neoplasm. A stricture of the anterior urethra, if nodular, can be palpated. The first manifestation may be a gleety discharge of long standing, free of gonococci. Increased frequency of urination may be unnoticed for a long time by the patient before it gives rise to discomfort. Later, with infection of the urethra and bladder, the urinary disturbance becomes more marked and may overshadow the obstruction. The urine may be clear except for shreds, or cloudy due to varying amounts of pus, mucus, etc. The latter is dependent on the chronicity, the degree and amount of infection of the urethra, prostate and glandular adnexa which invariably are involved in the course of the disease, and in more severe cases, the bladder or upper urinary tract (Fig. 10). Increasing difficulty of urination, decreasing size of the stream or loss of projectile force or dribbling may be noted.

With strictures of small caliber, residual urine is almost constant and in absence of treatment, irremedial damage to the blad-

Fig. 5. False passage in posterior urethra following instrumentation.

der and upper urinary tract may occur. Hypertrophy of the bladder wall may be followed by atony and false incontinence, really a type of retention with overflow. At any stage of this process, infection may extend to the upper urinary tract with grave secondary renal lesions. Retention may be sudden, partial or total and is due to the edema or congestion in the partly occluded canal. The symptoms are not indicative of the size of the stricture, any group may be present.

The same careful routine examination is carried out as with any other disorder of the lower urinary tract, consisting of: microscopic examination of the urethral discharge, if present; multiple glass test of voided urine, with macroscopic, chemical

and microscopic examination of the specimen; inspection and palpation of the urethra and external genitalia; bimanual rectal palpation of the prostate and seminal vesicles; microscopic and cultural examination of the prostatovesicular secretion; direct instrumental and endoscopic examination of the urethra; and urethrocystography.

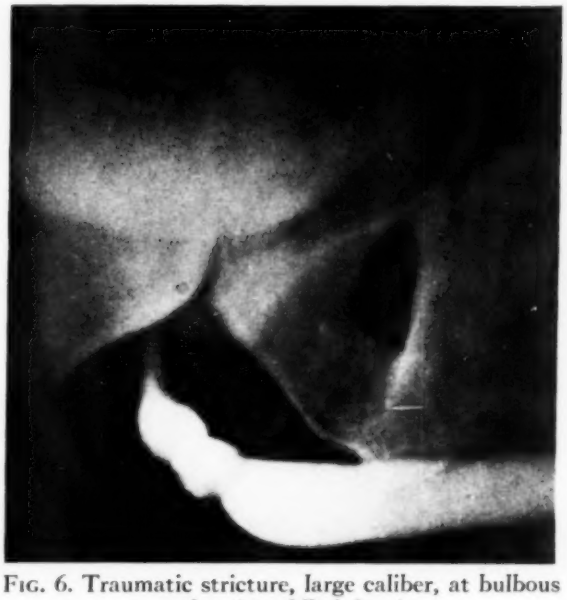

Fig. 6. Traumatic stricture, large caliber, at bulbous urethra (straddle injury).

Fig. 7. Traumatic stricture, filiform, at bulbomembranous junction (complete rupture of urethra).

Direct instrumental examination serves to locate and calibrate the stricture and demonstrate the number of coarctations. The primary requisites are meticulous asepsis and gentleness in technique. Clean hands and sterile instruments with plenty of sterile water-soluble lubricant are essential. The genitalia are prepared as for minor surgery, the anterior urethra lavaged with a mild antiseptic solution. If the utmost care is exercised and the cooperation of the patient obtained, local anesthetics, as a rule, are unnecessary. However, for the neurotic, apprehensive patient with a hypersensitive canal, the injection of a surface anesthetic such as urethrol or diothane, in a water-soluble lubricant, retained for ten minutes with a penis clip, will aid materially in relieving any complicating spasm and facilitate the examination. The instruments required are the bougie a boule, Phillips woven silk whips and followers, both catheters and bougies, whalebone filiforms, olive tipped bougies and conical tipped sounds. A sound which I have employed for many years has certain advantages over those in routine use. The curve is similar to that of the Van Buren. The distal 3 inches of the shaft are tooled down to a caliber several sizes smaller than the proximal portion. Its caliber is gradually increased in a half inch to the widest diameter from which point it tapers by degrees to a conical tip. It is easy of introduction and due to its narrowed shaft, the meatus and pendulous urethra are not kept on the stretch while the area of constriction is being dilated.

To determine an abnormal narrowing, a well lubricated sound of size 24 or 26 French is gently introduced into the urethra, almost of its own weight, its tip following the roof of the canal until its progress is arrested by an obstruction. If the meatus is too small for the passage of instruments, meatotomy should be performed. If the sound fails to "engage," smaller instruments are passed in succession until the lumen of the stricture is "fitted." The distance from the meatus to the area of constriction is then measured

on the shaft of the instrument. Sounds may be used above 21 or 22 French; a bougie a boule or olive tip bougie to size 10 or less;

Fig. 8. Inflammatory stricture, small caliber at bulbomembranous junction, with chronic infection and dilatation of urethral glands.

and for a filiform stricture, the Phillips whip with either catheter or bougie follower. It is well to remember at this point that sometimes a large sized instrument can be passed where a smaller is unsuccessful. However, if a large instrument fails to enter the opening, and is forced, it may so distort the stricture face as to make the insertion of a filiform more difficult.

For strictures of small caliber, the Phillips whip is far superior to the whale bone filiform; it will slip over slight obstructions, will not catch in every small opening or pocket, causes less trauma and its introduction is usually more successful. Unlimited patience and the utmost gentleness are essential for their treatment. A distorted crooked canal may give rise to considerable difficulty. If the whip fails to pass the obstruction, it is gently manipulated by advancing, withdrawing and rotating, and may in most instances, be "eased" through the opening. It may be necessary to bend its tip at an angle, gentle curve or double angulation, or make repeated attempts. For this purpose, one filiform carefully manipulated, is as a rule,

Fig. 9. Inflammatory stricture, small caliber, at bulbomembranous junction, with chronic infection and dilatation of Cowper's glands and prostatic ducts.

preferable to the use of several. It may pocket itself in a recess or become knotted, but the proof of a successful introduction is the ease with which it enters the bladder with its attached follower.

The cystourethroscope has distinct advantages in demonstrating the surface appearance of the mucosa and changes in the urethral wall. In the hyperemic stage the mucosa is engorged and succulent, has an inflamed appearance, bleeds easily and bulges into the visual field with the urethral opening as a central point with radiating lines; whereas in the anemic state, the mucosa is grayish-white and the urethral wall funnels from the end of the instrument to a central point. The zone of coarctation interferes with further introduction of

the instrument. The endoscope is of questionable value as a means of passing a filiform through the openings of multiple strictures, but may be indispensable for traversing a single stricture.

X-ray diagnosis by urethrocystograms delineates the character, site, size and number of strictures and demonstrates the presence of complicating factors in the urethra and bladder. If carried out with proper technique, it is a far safer diagnostic procedure than repeated instrumentation. It is particularly applicable to patients with small caliber strictures in whom instrumentation is difficult or impossible; who have chronic dilatation of the adnexal glandular structures such as of the glands of Littre, Cowper and of the prostate, or pockets and fistulous tracts. If however, instrumentation has been attempted, an interval of least forty-eight hours should elapse before the urethrocystogram is made.

The various methods of treatment are preventative, instrumental and surgical. The prevention of venereal disease, education of the layman as to the dangers and sequels of inadequate treatment, and a better understanding of the problems involved by the practitioner, are as necessary today as in former years. The present venereal program of our municipal, state and federal governments should be a distinct aid in eliminating one of the most prolific causes of stricture, i.e., gonorrhea.

Many strictures are amenable to office treatment, for the majority respond to gradual dilatation. Rapid dilatation by divulsion is mentioned only to be condemned; the lacerations caused by the too speedy forcible stretching with sounds, dilators, or tunneled sounds threaded over filiforms, result in an increased deposition of dense scar tissue. Each patient presents an individual problem, and consideration must be given to temperament, mental and social status as well as his physical condition.

In those patients presenting evidence of acute retention or partial obstruction, or if the stricture is of such size that a follower cannot be introduced, the filiform may be tied in place with the assurance that the

Fig. 10. Inflammatory stricture, filiform, at bulbomembranous junction, with false passage following instrumentation, chronic prostatis, prostatic calculi and small diverticulum of bladder.

urine will dribble alongside it, thus relieving the retention. At the end of twenty-four or forty-eight hours, the area of cicatrization will have softened sufficiently to permit several followers or bougies of successively larger sizes to be passed without difficulty. The bladder is lavaged and an instillation of a weak solution of silver nitrate 1:5000, or one of the organic silver compounds is made to the prostatic urethra before the follower is withdrawn. The re-insertion of an indwelling filiform is seldom necessary; the patient usually voids spontaneously. Further dilatation may be accomplished by gradually increasing the size of the followers, or passing olive tipped bougies, never more than two to three sizes at a time at intervals of three or more days. It

may be advisable to start with a size smaller than was used at a previous treatment. As the lumen of the canal dilates, the periods between instrumentation are correspondingly lengthened so that when sizes 20 or 21 French are reached, the intervals may be three weeks apart.

For the progressive dilatation, conical tipped steel sounds are employed at intervals of two or three weeks or longer. If the patient's condition warrants, these periods may be lengthened to intervals of two or three months or even six months. He should be warned that re-contraction will take place, and to insure against recurrence, dilatation must be continued over a long period of time. The lumen of each canal varies, and consideration must be given to the size to which a stricture can be dilated.

The only manifestation of a large caliber stricture (24 to 26 French) may be a prolonged gleety discharge. These patients are materially benefited by dilating the lumen of the canal to a considerably larger size, 30 to 32 French or even more.

Preliminary to and during the course of treatment of a constriction, the urinary tract must be rendered as aseptic as possible by urinary antiseptics and acidulation of urine, increased ingestion of fluids and a non-stimulating diet. Although dilatation promotes drainage and aids in the elimination of infection, supplemental treatment must be directed to the co-existing and complicating factors, to obtain more speedy and satisfactory results. In the presence of specific organisms, vaccines and bacteriophage are of distinct value.

The various types of surgical intervention by incision or excision are not office procedures. One or more of these methods are indicated in those relatively few patients in whom instrumentation is unsuccessful or is followed by bleeding or marked local or systemic reaction; or when the stricture is cartilaginous or resilient and gradual dilatation has failed. Internal or external urethrotomy or excision are indicated where marked infection and complicating factors such as urethral or vesical calculus, fistula, pockets, false passage or suppurative processes co-exist; or in those individuals who are unable or unwilling to cooperate in obtaining treatment.

With proper care and cooperation, the prognosis of stricture of the urethra is good. Its successful termination is dependent not only on thorough and regular treatment but on prevention, the eradication of infection and the anticipation and early recognition of such complications as will necessitate operative intervention.

SUMMARY

For the diagnosis and treatment of the varied types of stricture, urethrocystography, the roentgenographic delineation of the urethra and bladder with the use of an innocuous contrast medium is invaluable. It may be used alone, or to supplement other methods of diagnosis. Associated pathologic lesions of the urethra and glandular adnexa are graphically delineated by this method. The treatment of stricture is based on a knowledge of the etiological factors and the degree and extent of pathology present. Most strictures respond to gradual dilatation and other office procedures. The prevention of venereal disease and a better understanding of the need for early and adequate treatment will aid in the further reduction in the occurrence and severity of strictures.

REFERENCES

Béclère, H. and Henry, R. Radiography of urethral strictures. *Jour. d'Urol.*, 13: 417–424, 1922.

Burden, V. G. Roentgenology of the male urethra. *Surg. Gynec. and Obst.*, 38: 3, 1924.

Cunningham, J. H., Jr. The diagnosis of stricture of the urethra by roentgen ray. *Tr. Am. Assn. Gen.-Urin. Surg.*, 5: 369–371, 1910.

Funkhauser, S. P. Urethrography in the male. *Urol. and Cutan. Rev.*, 36: 644–650, 1932.

Hyams, Joseph A., Kenyon, H. R., Kramer, S. E., Urethrocystography in the male; *J. A. M. A.*, 101: 2030–2035, 1933.

Kohnstam, G. L. S. and Cave, E. H. P. The radiological examination of the male urethra. *Brit. Jour. Radiol.*, 30: 121–127, 1925.

Nicholson, M. A. and Fiala, M. J. Roentgenography of the urethra. *Jour. Urol.*, 28: 461–476, 1932.

Sicard and Forestier. Radiologic exploration of urethra with lipiodol. *Bull. Soc. mèd. d'Hôp. de Par.*, 40. 7, 1924.

REMOVAL OF FOREIGN BODIES FROM URETHRA AND BLADDER

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STONES of the bladder and stones lodged in the urethra are not foreign bodies in the precise sense as are those objects introduced into the urethra and bladder from without. As to their removal, however, both types of foreign bodies present much the same problem. From a practical standpoint, therefore, both urethral and bladder stones should be considered as foreign bodies.

It is not the purpose here to recount the varieties of urethral and bladder foreign bodies nor their modes of introduction. Briefly, however, it may be stated that almost every conceivable type of object, which is small enough to pass through the urethra, from nails to snails has been found in the human urethra or bladder. While a few foreign bodies have found their way to the bladder through violence (bullets) and some have migrated from other parts of the body (fracture pin) the great majority of objects in this category have been placed in the urethra for purposes of sexual gratification by the patients themselves or in the case of women attempting to induce abortions on themselves, the urethra being mistaken for the cervical canal.

The methods employed for the removal of urethral foreign bodies are (1) meatotomy, (2) urethroscopy, (3) internal urethrotomy, (4) dilatation of the urethra, and (5) external urethrotomy.

The employment of any one of the foregoing procedures may suffice to remove a foreign body from the urethra, particularly if the foreign body is a stone. Usually, however, a combination of two or more of the procedures is necessary and as a general rule the nearer the foreign body is to the urethral meatus, the more likely is the attempt to succeed.

Meatotomy. In the case of an abnormally small meatus, it is readily understood why a small stone, for example, which has travelled all the way from the kidney pelvis through the bladder and through most of the urethra without unusual incident, may become impacted at the fossa navicularis or possibly just within the meatus. Here meatotomy usually performed under local anesthesia (two or three drops of 1 per cent novocain are injected with a hypodermic needle into the glans in the midline on the ventral surface as close to the meatus as possible) will promptly release the stone.

Urethroscopy. Blind groping for foreign bodies with foreign body forceps, especially those of the alligator type, may be tried, but is rarely successful. It is rather difficult to grasp the foreign body without grasping the urethral mucosa as well. The latter danger may be obviated by the use of the urethroscope, preferably one of the endoscopic type. With the jaws of the forceps protruding beyond the endoscopic tube, an attempt is thus made to grasp the foreign body cleanly. If successful, traction is made on the forceps and on the endoscope at the same time, thereby removing the two instruments as a whole. In objects whose shortest diameter approximates that of the inside diameter of the endoscope, it is next to impossible to withdraw them through the tube.

Internal Urethrotomy and Dilatation of the Urethra. Since a urethral stricture may serve as a barrier to the passage of a foreign body, an internal urethrotomy may be indicated. If the stricture is of a

calibre sufficiently large to admit an Otis urethrotome, this should be the instrument of choice. In the event that the stricture

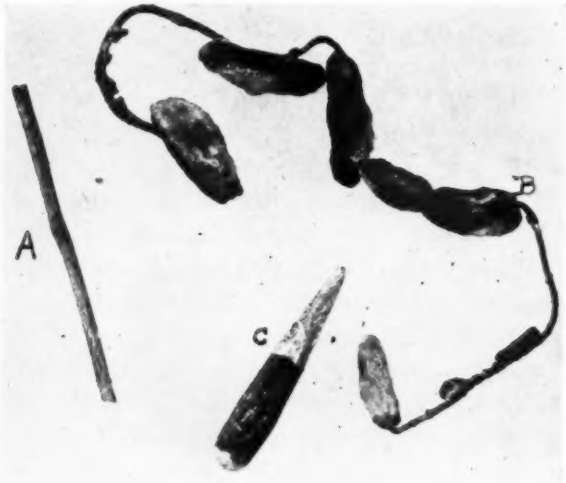

Fig. 1. Foreign bodies removed on the Bellevue Urological Service since September, 1936: A, a piece of wood about 7.5 cm. long and 0.4 cm. wide, found in bulbous urethra, complicated by periurethral phlegmon; removed by external urethrotomy. A few weeks later another piece of wood, twice as long, coated with incrustations and evidently the original of which A was a part, was found by cystoscopy, lying transversely in the bladder; latter was removed by cystoscopic means. B, filiform whip, nucleus for a string of stones, found coiled in the prostatic urethra which was greatly dilated; removed by suprapubic cystotomy. C, artist's easel peg, about 5.5 cm. long and 1 cm. in its widest diameter, found in deep urethra and removed by external urethrotomy.

All three patients made uneventful recoveries.

approximates filiform dimensions, the Maisonneuve instrument should first be tried, but this can probably be employed only when one is successful in passing the whip which acts as a guide, not only through the stricture, but past the foreign body as well.

After using the Maisonneuve urethrotome, if the narrowed portion of the urethra is still not large enough to permit the foreign body to pass, then further enlargement may be accomplished by means of the Otis instrument.

If the urethra posterior to the stricture is large enough to permit fairly free movement of the stone, it is quite possible to dilate the stricture by means of sounds. This can occasionally be done although the stricture may be filiform in size and should be attempted before resort is had to other more involved methods.

In 1930, the author reported the removal of a thin triangular piece of bone which had become engaged in the posterior part of the anterior urethra. A stricture about midway of the penile portion of the urethra rendered the manipulation of urethral instruments difficult. A filiform was finally passed, over which a 14 F. tunnelled sound was guided to the bladder. This afforded sufficient dilatation to permit the fragment of bone to be grasped with alligator forceps. While traction was made on the forceps, an assistant "milked" the urethra over the piece of bone, thereby materially assisting in propelling it forward.

Stones and other foreign bodies in the posterior urethra which cannot be brought out through the external meatus may sometimes be pushed into the bladder by means of a sound. They are then treated as foreign bodies of the bladder.

External Urethrotomy. The indications for this procedure are (1) failure to remove the foreign body by other methods, (2) the presence of a complicating tight stricture of the deep urethra, and (3) the presence of a complicating periurethral abscess or phlegmon.

A word of warning as to what portion of the urethra should be cut from without is here in order. Whenever at all possible, the incision into the urethra should be made posterior to the pendulous portion, although the foreign body may lie anterior to this point. In other words, the usual perineal external urethrotomy should be performed. If the incision is not directly over the foreign body, it may be necessary with the aid of forceps to pull the foreign body backwards or forwards in order to extract it through the urethral wound.

For foreign bodies anterior to the external urethrotomy wound, success is sometimes had by pushing the object backwards with a sound in the anterior urethra while traction with forceps is made from behind.

Only as a last resort should an incision be made directly over a foreign body which is situated in the penile urethra for a fistula is almost certain to follow. Such a fistula rarely if ever closes spontaneously and is exceedingly difficult to repair by operative measures.

But when all other methods to remove a foreign body from the penile urethra have failed and it becomes absolutely necessary to incise the urethra directly over the foreign body, the urinary stream should be diverted in order to promote healing and to avoid a urinary fistula. If in the attempt to remove the same foreign body an external urethrotomy of the deep urethra has preceded the more anterior urethrotomy, the drainage can be very handily established by placing a perineal tube into the bladder through the deep urethrotomy wound; otherwise drainage should be established by either a posterior external urethrotomy or by means of a suprapubic cystotomy.

Foreign Bodies in the Bladder. As in the case of the urethra, the simpler non-operative methods of removing foreign bodies from the bladder should be tried first unless the patient's condition is such that temporizing may place his life in jeopardy. The method of choice depends largely on the type and size of the object to be removed. Usually the foreign body is removed by employing one of the five following procedures: (1) cystoscopy, (2) injection of solvents, (3) litholapaxy, (4) suprapubic cystotomy, or (5) external urethrotomy.

Cystoscopy. Objects small enough to pass through the urethra can frequently be removed in toto by means of the operating cystoscope and foreign body forceps. As suggested in the endoscopic removal of urethral foreign bodies, it is not infrequently best, after grasping the object to allow the forceps to protrude beyond the end of the scope and remove the scope, forceps and foreign body as a whole rather than attempt to pull the object through the cystoscopic sheath.

Small stones whose smallest diameter is larger than the cystoscopic sheath may be broken into two or more fragments and the fragments removed individually with a foreign body instrument or aspirated through a cystoscopic sheath or a Bigelow evacuating tube. Satisfactory instruments for the purpose are the cystoscopic rongeurs of either Young, Lowsley or Ravich. The McCarthy evacuating bulb is an excellent aspirator.

Injection of Solvents. Quite a number of instances are recorded wherein portions of paraffin and wax in the bladder have been dissolved by various solvents. Notable among these are the following case reports:

1. After experimenting with xylene, kerosene, paraffin oil and gasoline as well as varying proportions of these solvents, Caples removed a piece of paraffin from the bladder by several injections of 33⅓ per cent gasoline in paraffin oil; 125 c.c. of the mixture were given at each injection at a temperature of 110 degrees F. and the solution was retained from two to five hours. The paraffin was exposed to the solvent for a total of seventeen hours during a three day period. The paraffin was recovered from the expelled bladder contents by chilling the solution whence precipitation of the paraffin took place. A week after the process was completed, the patient was cystoscoped and no foreign body was seen.

2. Turner has reported the removal of a piece of paraffin about the size of a 4 inch segment of lead pencil by employing xylol as a solvent. He introduced a No. 20 F. catheter, filled the bladder with sterile water and then injected 12 c.c. of xylol. After keeping the patient in the recumbent posture for thirty minutes, during which time the bladder region was massaged at frequent intervals, the fluid was withdrawn. The last portion of the fluid was of a milky appearance. A little later, cystoscopic examination showed no foreign body. Five days later, the report from the patient's physician stated that the patient was entirely normal.

3. Katzen, influenced by the success of Harris in the employment of liquid petrolatum as a solvent for paraffin was successful in removing three portions of a paraffin candle which were attached to one another by the wick. Previous attempts had been made to grasp the candle with cystoscopic forceps, but without much success. Katzen injected 100 c.c. of warm, sterile, liquid petrolatum through a rubber catheter and then thoroughly massaged the suprapubic region. The patient was instructed to hold the solution as long as possible and to massage the bladder region at intervals. The following day, the bladder was irrigated with a 1:5000 mercuric oxycyanide solution and another injection of 100 c.c. warm, sterile, petrolatum was again made. Suprapubic massage was instituted as before. On each occasion the patient was able to retain the oil for two to three hours without any evidence of bladder irritation.

Two days later, the patient was reexamined by cystoscopy and neither the wax nor the wick was visible, the latter apparently having been passed without the patient's knowledge.

Litholapaxy. While the lithotrite, as the name implies, is an instrument designed for crushing stones, it is sometimes used for breaking up other foreign bodies in the bladder which lend themselves to this mode of attack. It is difficult to make any rule governing the size of a stone which may be appropriate for litholapaxy. An important factor concerning this point is the hardness of the stone. But generally speaking any stone whose shortest diameter is no greater than 3 cm. may be crushed.

Unless contraindicated by certain forms of bladder neck obstruction, diverticula, the size of the stone, or for some other equally specific reason, litholapaxy should be the method of choice for the removal of bladder calculi. When performed by one skilled in the method, the mortality is less and the period of hospitalization far shorter than if the stone were removed by means of an open operation.

In any type of prostatism complicating stone in the bladder, due consideration must be given the bladder neck obstruction. If the stone is removed and the obstruction is ignored, other stones are almost certain to follow.

In the lesser types of obstruction (e.g., median bars and the sclerotic prostate), the bladder stone may be crushed and at another sitting the obstruction may be resected transurethrally. In the generally enlarged adenomas of the prostate or in patients with poor kidney function, the two stage suprapubic prostatectomy is usually the procedure of choice, the stone being removed at the time of the suprapubic cystotomy (the first stage of the operation).

Suprapubic Cystotomy. This procedure is reserved for those foreign bodies which cannot be removed by the non-operative and cystoscopic methods and also for those cases complicated by the types of prostatism which are not especially amenable to transurethral resection. In addition to stone, the kind of foreign body requiring suprapubic cystotomy for its removal may be most any object which is small enough to enter the bladder via the urethral route and also the comparatively rare objects which have either entered the bladder through gunshot wounds (bullets) or have migrated there from other portions of the body. Belonging to the latter class are a steel pin (inserted into the neck of the femur in the treatment of fracture), paraffinoma (following injection for hernia and a bullet which had lodged originally in the upper portion of the thigh). Among common objects which were inserted into the urethra and removed from the bladder by means of suprapubic cystotomy, the following noteworthy examples were encountered on the Bellevue Urological Service during the past twenty years: rubber catheters and pieces of rubber tubing, portions of lead pencils and other smooth pieces of wood, portions of glass thermometers, a glass vial and other smooth pieces of glass, portion of metallic sound, pipe stem, hair pin and hat pin.

Nearly all such objects may serve as nuclei for stone formation and for this reason, many suprapubic cystotomies which are required for the removal of incrusted foreign bodies could be avoided if the patient would seek medical aid as soon as he realized his own inability to recover the foreign body. Thus a clean hair pin in the bladder is ordinarily very easily recovered by means of an operating cystoscope and foreign body forceps, but a hair pin buried within a stone is a very different proposition.

Stones within Diverticula. The removal of stones within diverticula usually necessitates suprapubic cystotomy. Even then with the bladder wide open, it is not always easy to remove such stones. If the stone or stones can not readily be evacuated, the diverticular opening should be enlarged. If the diverticulum is situated on the posterior wall of the bladder and can be reached by an assistant's fingers introduced into the patient's rectum, considerable help may be given the operator by the assistant's efforts to push the stone out of its pocket. In certain instances, especially in aged individuals where the diverticulum and stone are both very large and not easy of access, and provided the stone is not the cause of any great amount of discomfort to the patient, it may be wiser to allow the stone to remain than to subject the patient to a major procedure, the shock or possible complications of which might cause his death.

External Urethrotomy. If the foreign body is not too large to pass through the posterior urethra, external urethrotomy may be preferable to suprapubic cystotomy in certain instances. Other things being equal, this would apply to patients with tight strictures of the deep urethra and individuals with very large pendulous abdomens.

REMOVAL OF FOREIGN BODIES BY MEANS OF SPECIAL TECHNIQUE

A few foreign bodies both in the urethra and in the bladder have been removed by means of methods which do not fall under any of the above classifications:

1. *A bat pin, the head of which evidently lay in the posterior urethra or the bladder.* Several inches of the shaft of the pin protruded through the dependant portion of the penis. The pin was removed by the following non-operative maneuver: By firmly grasping the shaft of the pin near its end, the head was pulled forward into the urethra as far as possible. The shaft was then inclined backwards reversing the original positions of the head and the point, while steady forward pressure against the head through the shaft was maintained until it finally passed through the external meatus.

2. The following most unusual method of foreign body removal was reported by Schulte:

A boy who had inserted a paraffin pencil into his urethra and lost control of it came for medical aid. On cystoscopic examination, a small mass of paraffin was seen at the edge of the air bubble. By means of a cystoscopic rongeur, several pieces of paraffin were chipped off, but the patient began to have pain and the procedure was stopped. Noting that the paraffin floated on the top of the irrigating medium, Schulte suggested that the patient try urinating when standing on his head. Two weeks later, the patient returned for re-examination. He said he had forced fluids and when his bladder became distended, he hung head down from a trapeze and urinated, whereupon the piece of paraffin was expelled. Another cystoscopic examination at this time revealed a normal bladder.

3. The difference in specific gravity between the irrigating medium and piece of wax makes it possible to remove the latter by cystoscopy:

O'Neil in attempting to remove a piece of wax crayon by means of cystoscopy, noted that the foreign body floated in the boric acid medium in such a way that it could not be grasped. He emptied the bladder and then filled it with olive oil

whereupon the wax sank to the floor where it could be readily grasped with cystoscopic forceps. O'Neil states that the procedure was less painful than ordinary cystoscopic examinations where water is employed, but believes that mineral oil would be better than olive oil for the reason that it does not turn rancid.

4. *Cystoscopic Removal of a Snail.* Though quite unique among foreign bodies of the bladder, snails according to Mauterer present no especial difficulty in their removal. In the case of an epileptic girl who had obviously put two snails into her own bladder, one was passed spontaneously and alive while the other, dead, was removed by cystoscopic means.

KIDNEY FUNCTIONAL TESTS

Before any extensive attempt is made (operative or otherwise) to remove a foreign body from the urethra or bladder, adequate kidney functional tests should be performed. It is not difficult to overlook the fact that the patient's kidneys may suffer as a result of back pressure due to an impacted urethral foreign body or a foreign body in the bladder which greatly interferes with the act of urination. This point is well illustrated by the following brief outline of the treatment instituted in the case of a twenty-one year old male who was admitted to the Urological Service of one of the large New York City hospitals a number of years ago, before the days of blood chemistry and intravenous urography. It was not the custom then as it is today to perform routine renal functional tests on all urological patients, especially those who pathological conditions were seemingly amenable to minor surgery.

An *x*-ray picture showed the shadow of a stone about the size of an ordinary olive, located apparently in the prostatic urethra. By rectal-digital palpation, a hard object could be felt in the midline of the prostate gland. The patient appeared to be in good general physical condition and a suprapubic cystotomy was performed. The diagnosis was confirmed. A stone was found in the prostatic urethra and was readily removed. A suprapubic drain was inserted into the bladder and the patient was sent to his bed in good condition. Three days later the patient died of uremia. Had it been recognized before operation that the boy's kidneys were probably badly damaged as a result of prolonged urinary obstruction, the proper procedure would have been a suprapubic cystotomy with drainage, constituting one operation and then later, after the kidney function had improved, removal of the stone through the cystotomy wound.

A patient, therefore, with a foreign body in the urethra or in the bladder, which has caused considerable kidney damage should be treated in much the same way that a prostatic patient is treated where the two-stage method of prostatectomy is contemplated. The first operation should be a suprapubic drainage in order to permit the kidney function to improve. The second operation should be removal of the foreign body, either suprapubically or by means of an external urethrotomy or perhaps by some other measure which might necessitate considerable urethral manipulation.

SUMMARY

1. Because of similarity of technique employed in their removal, urethral and bladder stones are included along with the other types of foreign bodies.

2. Methods usually employed for the removal of urethral foreign bodies are meatotomy, urethroscopy, internal urethrotomy, dilation of urethra, external urethrotomy. Concerning external urethrotomy, the impropriety of opening the pendulous urethra directly over a foreign body is stressed.

3. Methods usually employed for the removal of foreign bodies in the bladder are cystoscopy, injection of solvents, litholapaxy, suprapubic cystotomy, external urethrotomy.

4. Attention is called to several cases of foreign bodies whose removal was accomplished by means of special techniques.

5. The importance of a knowledge of renal function before resorting to operative procedures is stressed.

REFERENCES

Ravenswaay. Steel pin inserted into neck of femur found in bladder. *Am. Jour. Surg.*, 31: 566, 1936.

Jeck. Foreign bodies in the urethra. *Am. Jour. Surg.*, 9: 335, 1930.

Caples. Foreign bodies in the urinary bladder. *Surg. Gynec. and Obst.*, 29: 315, 1919.

Turner. A foreign body of paraffin in the urinary bladder removed with xylol as solvent. *Jour. Urol.*, 33: 471, 1935.

Katzen. Paraffin foreign body in the bladder. *J. A. M. A.*, 105: 1422, 1935.

Harris. A case of paraffin foreign body in the bladder. *Med. Jour. and Rec.*, 134: 372–374, 1931.

Whittaker. Paraffinoma following injection for hernia with ulceration into bladder. *Proc. Staff Meet. Mayo Clinic*, 11: 22–25, 1936.

Picatoste and Silio. Emigration to urethra and bladder of bullet tolerated 12 years in upper left thigh. *An. Casa de Salud Valdecilla*, 6: 311–315, 1935.

Schulte. A novel way of ridding the bladder of paraffin. *Jour. Urol.*, 34: 313, 1935.

O'Neil. Personal communication; also see Trans. New England Branch A.U.A., 1930–1931, p. 24.

Mauterer. Foreign body in urinary bladder. *Am. Jour. Surg.*, 32: 178, 1936.

HYDROCELE AND VARICOCELE: OPERATIVE AND INJECTION TREATMENT

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PHILADELPHIA

THE tunica vaginalis testis is derived entirely from the peritoneum through the descent of the testicle. The visceral layer invests the testicle and epididymis completely, except at their point of attachment, to each other and posteriorly where the vessels and nerves enter the organs. This layer is continuous with the parietal layer, which, when the funicular process is obliterated forms a closed sac with its proximal limit just proximal to the head of the epididymis. The coverings of the testicles are independent and completely separate.

The term hydrocele implies a collection of serous fluid within the cavity of the tunica vaginalis testis greater than the small quantity necessary to moisten its surface and considered to be normal. Any irritation affecting the tunic, primarily, or secondarily, from testicle or epididymis, gives rise to an effusion into its cavity; absorption is limited and results in a hydrocele.

A failure of the funicular process to become completely obliterated allows a variety of abnormalities depending on the anatomical variation present. Some writers designate as hydrocele, collections of fluid in the canal of Nuck, in the female.

The following classification, according to location, (Jacobson) is convenient and is standard in the recent literature.

1. Hydrocele of the testis.
   - A. Hydrocele of the tunica vaginalis.
     - (1) Ordinary type, distending the tunic.
     - (2) Congenital type, communicating with the peritoneal cavity.
     - (3) Infantile type, tunica vaginalis and a part of the funicular process, distended with fluid, no connection with peritoneal cavity.
     - (4) Inguinal type, hydrocele accompanies an undescended testicle.
   - B. Encysted hydrocele of testis and epididymis.
     - (1) Occurring as encysted hydrocele of the epididymis, where the two layers of the visceral tunica vaginalis pass from the testis to the epididymis.
     - (2) Occurring between the tunica albuginea of the testicle and the visceral layer of the tunica vaginalis.
2. Hydrocele of the spermatic cord.
   - A. Diffuse type, or serous effusion resembling edema of the cord.
   - B. Encysted type, resulting from unobliterated portions, of the funicular process, or from the organ of Giraldes.
3. Hydrocele of the sac of a hernia, occurring where there is a serous effusion into the sac, the contents of which have been reduced with subsequent obliteration of the neck of the sac.
4. Various combinations of these three types of hydrocele.

Hydrocele is of rather frequent occurrence, comprising from 2 to 4 per cent of urological admissions. It is much more common in the tropics; some authorities state as high as 10 per cent. It occurs at any age, but is rare in infants. About 50 per cent of the cases occur after the age of forty years. Some writers suggest a causative relationship with the genital vascular changes incident to declining sexual func-

tion. The condition is bilateral in about 4 per cent of cases. In unilateral cases one side is involved about as often as the other.

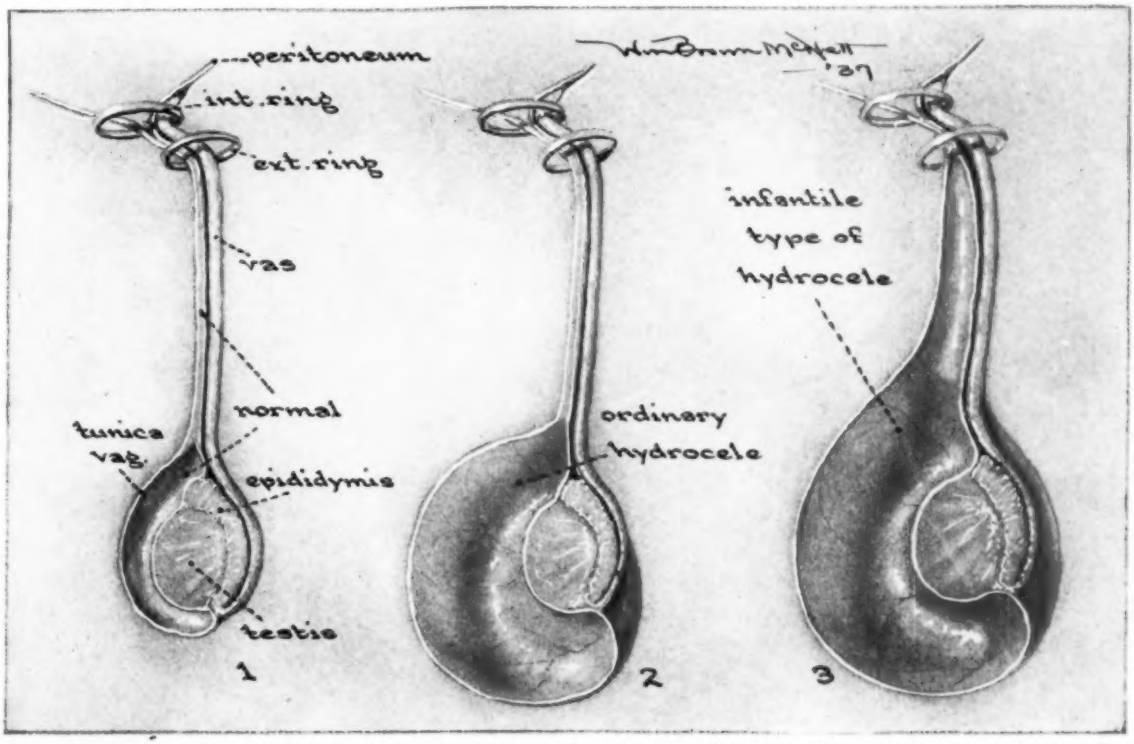

Fig. 1. Schematic drawing showing (1) normal relationship of the tunica vaginalis testis, (2) simple hydrocele; the most common type, (3) the somewhat rarer infantile type of hydrocele.

The condition may be acute or chronic. It may be symptomatic or idiopathic. Keyes reminds us that all of the symptomatic cases are not acute but that all of the idiopathic cases are chronic.

Infection of the epididymis or testicle and trauma to these structures or the spermatic cord are the principal causes of acute hydrocele. Young states that Francis Hagner encountered 31 instances of hydrocele while operating on 33 patients with acute gonorrheal epididymitis. It quite commonly follows operation for hernia or varicocele. It is said to be common during the course of the first year of inadequately treated syphilis. It may occur during the course of typhoid fever, pneumonia, etc. The acute and symptomatic types normally disappear spontaneously or after tapping, and treatment of the cause; or, they may persist as a chronic hydrocele.

Chronic idiopathic hydrocele is the type with which we are chiefly concerned. The etiological factor in this condition is difficult and in more than 50 per cent of the cases (311 or 502 in Campbell's series) impossible to determine. As a rule the condition is insidious in its development. Campbell and others believe that chronic inflammatory change in the epididymis is the etiological factor in the majority of cases. Certainly, induration of varying degree is a usual finding on routine examination of the epididymis, of men passed the age of forty years. It is indeed difficult to find one in whom some palpable change may not be detected and it is certainly most common to find chronic changes at operation on these patients. I am inclined to agree with the theory of epididymal inflammatory reaction, but I have no proof to offer. The condition is said to be common among those whose occupation subjects them to scrotal trauma; cowboys and circus riders are examples.

The fluid in uninfected, uncomplicated hydrocele is clear and resembles urine. Its specific gravity is 1020 to 1026; it contains from 4 to 6 per cent of albumin, some

fibrinogin, sometimes cholesterin, a trace of glucose, salts, fibrin and occasionally fibrous bodies impregnated with lime salts. careous plates. Occasionally villous growths are found, and when adhesions are present the sac becomes multilocular.

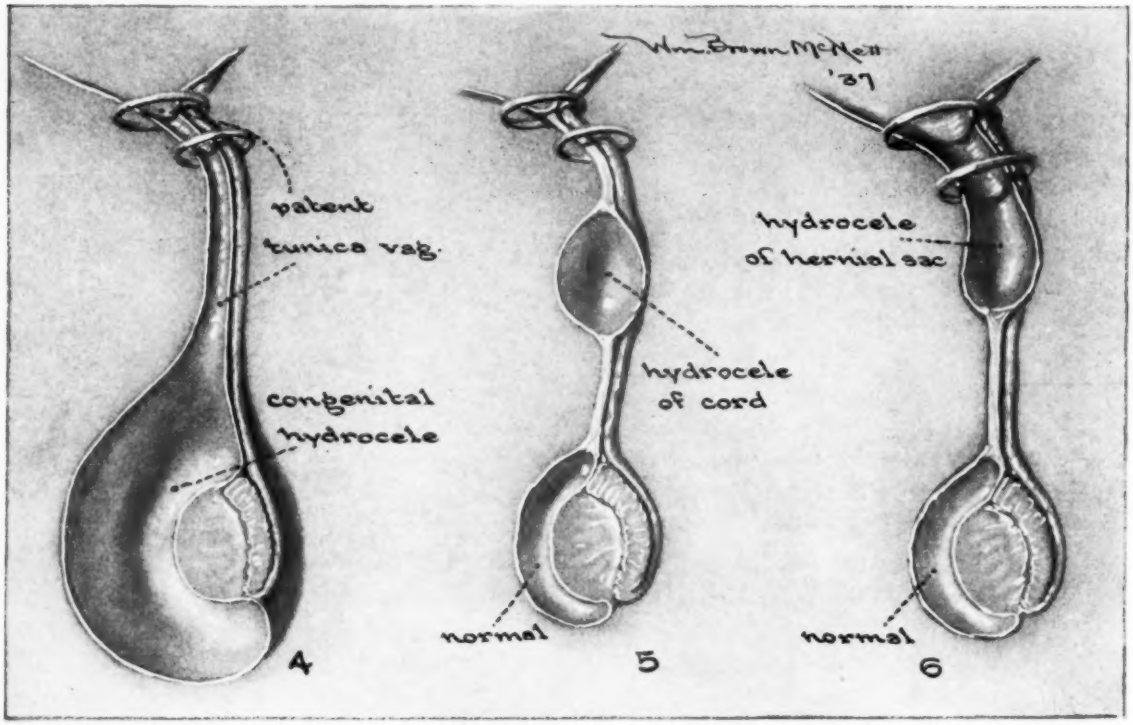

Fig. 2. Schematic drawing showing (4) congenital hydrocele, (5) hydrocele of cord, (6) hydrocele of hernial sac.

Microscopically the fluid contains a few endothelial cells, leucocytes, cholestrin crystals and lecithin bodies. Spermatozoa may be present, probably, as the result of rupture of a spermatocele into the sac, red blood cells, in the event of hemorrhage, and bacteria in the infected cases. Carforio reasoned that the fluid was an exudate because of its albumin content and high specific gravity. That the condition is seldomly found in connection with varicocele adds additional weight to this hypothesis. The character of the fluid changes with infection and hemorrhage. The quantity of the fluid varies from a few cubic centimeters to several hundred. Campbell, quoting Carforio, states that five gallons is the greatest quantity yet reported.

The wall of the sac may be thin and glistening, or, in older hydroceles, thick and leathery, and the serous surface covered with irregular fibrous, cartilagenous or cal-

Hydrocele may produce atrophy of the testicle in time as the result of pressure and possibly because of the interference with its thermoregulatory mechanism.

Pain varying with the etiology and rapidity of onset is often present in acute hydrocele, but is rare in the chronic type. The usual complaint in the chronic variety is a dragging sensation, and relief is often sought because of the inconvenience and unsightliness of the mass.

The diagnosis of chronic idiopathic hydrocele is usually not difficult. An accurate history is of very great value. The typical unilateral case presents a pyriform mass in the scrotum with the stem upward. The scrotal wall may be tense and shiny or appear normal depending on the quantity of fluid present. On palpation there is a tenseness and yet the mass is compressible and resilient. The testicle and epididymis are usually situated in a postero-inferior

position and may or may not be definitely palpable. They may, however, occupy an anterior position. The upper limit of the sac predominate may transmit light and fluctuate. Biological tests may help. Gumma is suggested by the history, positive Wasser-

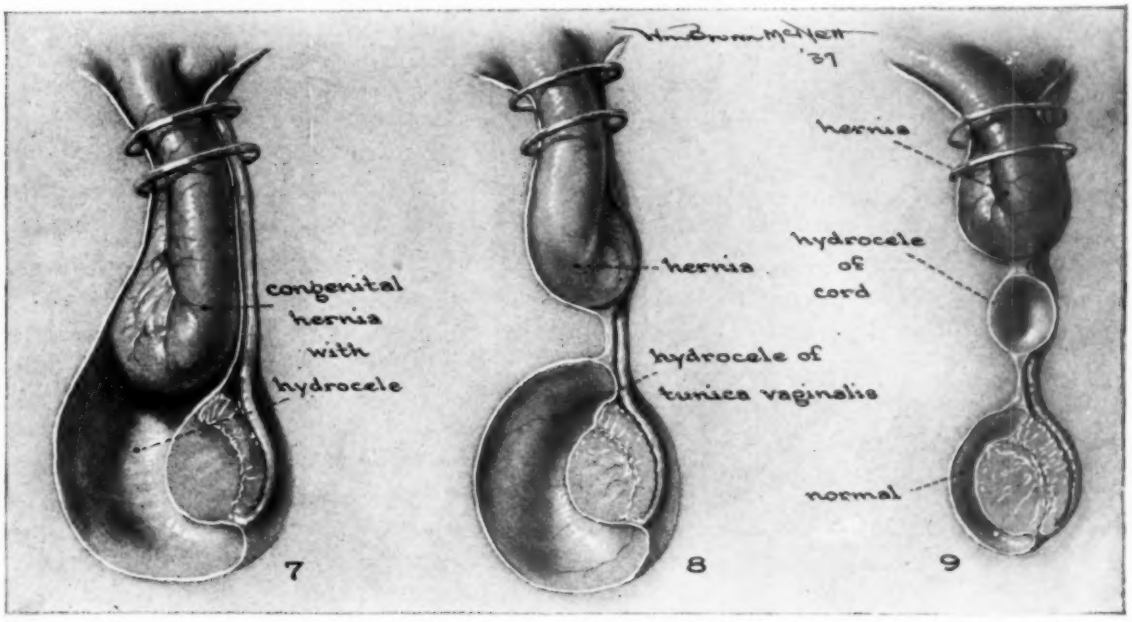

Fig. 3. Schematic drawing showing (7) congenital hernia with hydrocele, (8) simple hydrocele and hernia, (9) hernia and hydrocele of the cord.

may be outlined and the cord isolated proximally. There is no cough reflex transmitted into the sac. Finally, the sac is translucent, and when the testicle cannot be palpated, its shadow may be seen by transillumination.

Hydrocele must be differentiated from hernia, tumor of the testicle or epididymis, gumma, hematocele, spermatocele, cyst, and chylocele.

Transillumination may fail if the fluid is cloudy or bloody, in thickened sacs and in Negroes. It is sometimes demonstrable in cysts, certain tumors, and in hernia, especially in children.

Hernia should offer little diagnostic difficulty. Hernia and hydrocele may occur as separate entities while the former is often associated with congenital hydrocele. Tumor and hydrocele differ in consistency; the former is solid and heavy, the latter lighter and resilient. The history should aid in differenting the two conditions. It must be remembered that some teratomata in which cartilage and mucoid material mann reaction, and other findings suggesting this disease.

Spermatocele may be associated with hydrocele and perhaps rupture into the sac. It may be single or multiple and cannot be diagnosed with certainty in every case; its position in relationship to the testicle and to the epididymis might help. The fluid in spermatocele contains little serum albumin, and the specific gravity is low (1002–1006) which differs considerably from the serum-like fluid of hydrocele. At any rate it is a matter of small importance if open operation is performed.

Hematocele may occur spontaneously. It is rare and usually due to trauma. It is remarkable that it does not occur more often as a sequel to tapping.

Chylocele, rarely encountered in the temperate zone, is a common complication of filarial infection. The aspirated fluid is milky and when allowed to stand, a layer of fat accumulates on its surface.

Hydrocele must be considered in the differential diagnosis of an abdominal mass

associated with undescended testicle. Congenital and infantile hydrocele may be associated with hernia and difficult to

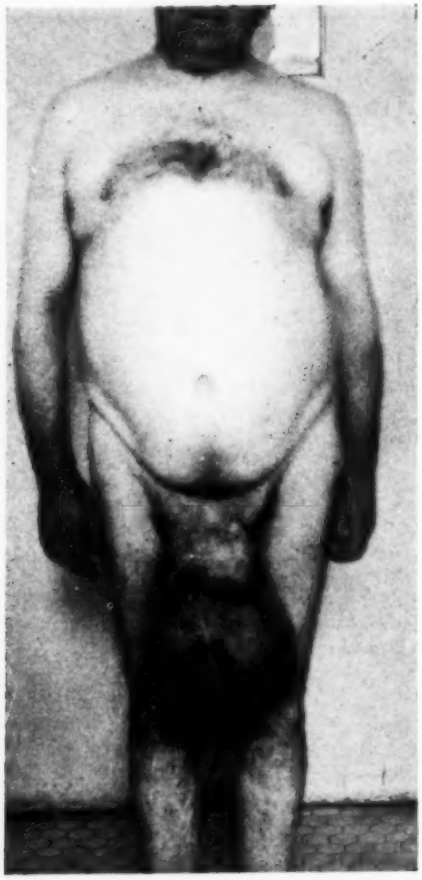

Fig. 4. Right idiopathic hydrocele of thirty years duration. Patient, aged fifty-five years, states that it had never been tapped. Note the complete disappearance of the penis. (Courtesy of Dr. M. B. Dewire.)

differentiate. The cough impulse is present. Transillumination is untrustworthy and tapping should not be done if there is doubt.

Diffuse hydrocele of the cord is difficult to diagnose with certainty; if there is a single or multiple cysts, it is comparatively easy. Transillumination is the only positive sign. The same applies to hydrocele of a hernial sac. A history of previous hernia is helpful. Lipoma of the cord may be confusing.

Abdominoscrotal hydrocele (hydrocele en bissac) is the rarest form of hydrocele. The method of its formation is not entirely clear. It seems possible that it might be the result of an invagination of a simple hydrocele sac through the inguinal canal to burrow up between the peritoneum and anterior abdominal wall or between the pelvic peritoneum and pelvic wall. There is an hour-glass constriction where the sac passes through the inguinal canal. A fluid wave may be detected in one segment by pressure over the other, and both sacs may be emptied by tapping one of them. In all of the reported cases the patient has noted the scrotal swelling first, and apparently two to three liters of fluid may collect in the abdominal segment before it creates attention.

The treatment of hydrocele varies with the condition with which we have to deal. As has been mentioned the treatment of acute and symptomatic hydrocele consists largely in the treatment of the underlying pathology. Tapping may be indicated. The condition either disappears with the causative lesion, or persists as a chronic hydrocele.

The congenital hydrocele of infants usually disappears spontaneously. A small percentage may persist as such to adult life. The associated hernia occasionally demands attention. I encountered recently a strangulated hernia associated with congenital hydrocele in a very young infant.

The radical operative treatment of hydrocele is, in our experience, a most satisfactory procedure. Eversion of the sac is done, in suitable cases, with thin-walled sacs. If the sac is large, a portion is excised sufficient to permit approximation of its edges, behind the epididymis without leaving too much redundant tissue. Care must be used to incise the sac from pole to pole or there may remain a pocket that will refill. Partial or complete excision without eversion is appropriate for thick or unusually large sacs. If the epididymis is considerably diseased we do not hesitate to remove it; this makes for a much more satisfactory and cleaner operation. It cannot be stated too often that secondary

hemorrhage is a troublesome factor and that hemostasis at operation must be absolute. The high frequency coagulating current is useful for this purpose. We usually drain for twenty-four hours, the scrotum through a counter incision and have never seen troublesome secondary hemorrhage or infection follow its use. Postoperative hemorrhage may be very troublesome and is not infrequently followed by deep secondary infection with loss of the testicle in some instances, (8 times in Campbell's series).

We prefer inhalation or spinal anesthesia; local anesthesia is not entirely satisfactory and quite possibly contributes to the frequent occurrence of secondary infection, in certain reported series of cases.

Atrophy of the testicle is present in many cases before operation.

It is difficult to ascertain the effect of operation in this situation.

Hospitalization is necessarily longer following total excision of the sac than in simple eversion, and the irregular tender lump that persists in the scrotum for a long time following the former is disturbing to most patients.

Bruns noted recurrence in 2.4 per cent of 1216 operated cases.

The average hospitalization in Campbell's series was 9.4 days.

The principle of injecting sclerosing solutions into the sac of a hydrocele is a very ancient one. A great many substances, much too numerous to mention in this paper, have been employed. Among these, however, iodine which was introduced in 1832 by Martin seems to have been very widely used. One hospital reported 2393 cases treated within a seven year period soon after its introduction, with success, in practically all. This substance caused pain and a disability requiring confinement to bed of from eight days to several weeks in some cases. There was a considerable percentage of abscesses and sloughs. Recurrence, in general, was undoubtedly high. Phenol which was suggested some forty years later was less painful than iodine but otherwise was open to the same objections, and in addition there were some cases of phenol poisoning reported. This method of treatment was largely discarded with the perfection of operative procedures, but since the introduction of sclerosing solutions in the treatment of varicose veins, a new interest has been awakened in the injection treatment of hydrocele. Killburne and Murray published a paper in 1932 which I think will come to be regarded as a classic. They state that the ideal solution must possess the following properties:

1. It must be painless.
2. It must not cause disability.
3. It must be efficient in destroying all hydroceles with recurrence.
4. It must not be dangerously toxic.
5. It should be bactericidal.
6. It must not subject the patient to the danger of hemorrhage into the sac following the injection.

After much experimental investigation, it was found that quinine hydrochloride 13.33 per cent and urethane 6.66 per cent meet very nearly the outlined requirements for the ideal solution. It is subject to the objection that while it will bring about a cure of hydrocele, it is not as efficient as a solution of quinine dihydrochloride 13 per cent. However, this solution causes some pain. Accordingly, they use the first solution for the first injection, and for subsequent injections employed the second solution, and state that these subsequent injections are painless.

One gathers the impression from the literature that these sclerosing solutions produce an obliteration of the sac by the production of fibrous tissue. This opinion, however, is not supported by open operation and actual investigation. Ewell and his co-workers operated upon one of their patients one month after the last of three injections with quinine hydrochloride and urethane; their findings were that,

> There was a small amount of dark amber fluid and several long, loose strands of attached and organized fibrin. Grossly the testicle and epididymis appeared normal. Microscopic sec-

tion of the tunic wall showed the endothelium to be intact, the blood vessels appeared normal though the subserous layer of the tissue was distinctly thickened and infiltrated with organizing fibrous tissue.

From this one case they suspect that the resulting fibrosis of the tunic wall following injection so interferes with the blood and lymph supply of the endothelium, that in some way it alters the process of fluid formation or reabsorption.

The injection is done with a Luer type syringe and a needle of rather small caliber, 17 to 20 gauge. The skin is tunnelled before penetrating the tunic. After the sac has been completely emptied the fluid is examined microscopically for pus and blood, and careful palpation of the scrotal contents is done for detection of pathological changes in the testicle and epididymis. Two to 4 c.c. of the quinine and urethane solutions are injected, the needle withdrawn and by manipulation an effort is made to distribute the solutions throughout the sac. A snug bandage or suspensory is applied and the patient allowed to go his way. Fluid nearly always reaccumulates within one week after the first injection. The procedure is repeated at that time using quinine dihydrochloride, 3 to 10 c.c. Should fluid again form, an interval of three weeks is allowed before repeating subsequent injections. The fluid aspirated after the first injection is hazy and contains fibrin. Some cases require only one injection, but the average case requires two to three, and occasionally an even greater number is necessary. Should epididymo-orchitis develop, as it occasionally does, during the course of the treatment, it must be allowed to subside before continuing.

Injection treatment may be employed with safety and with assurance of good result in simple chronic sterile hydrocele. It is not indicated in the congenital variety or where there is serious pathology present in the testicle or epididymis. It is not suitable where haste is a necessity. Sacs of 1200 c.c. capacity have been treated successfully by injection. The procedure is simple and may be readily carried out as an office procedure. Few require sedatives or confinement to bed.

There have been, as yet, no large series of cases reported. There are, however, many small series and the results compare favorably with the reports of the operated cases.

An assistant is desirable and almost a necessity in tapping and injecting a hydrocele. I find very frequently that it is impossible to drain the sac completely even with assistance. This fact is believed to be responsible for some of the failures when injection is done. I do not believe that injection treatment should be substituted for radical operation under usual circumstances.

In a certain number of patients tapping alone seems to be the desirable form of treatment for one reason or another. It does not affect a cure. We have a number of patients whom we have tapped, at intervals of from three to nine months, over a period of ten years, and there has never been a complication following this procedure.

VARICOCELE

Varicocele may be defined as an affection of the veins of the pampiniform plexus comparable to varicose veins occurring in any other part of the body. We recognize a symptomatic and idiopathic type of varicocele.

The symptomatic type is rare, occurs usually in older men, involves either side with equal frequency and causes little or no discomfort. This type develops promptly and may attain large size. The veins empty slowly, if at all, when the patient is recumbent. Symptomatic varicocele is caused by mechanical pressure exerted on the spermatic vein either within the inguinal canal or the abdominal cavity. The condition is most often produced by tumors of the kidney but may be caused by any retroperitoneal mass, by a hernia, a truss or tumor in the inguinal canal.

Idiopathic varicocele is said by some writers to be present in from 15 to 20 per

cent of all young adults, while others state that it is present in some degree in practically all. It is generally believed that the sexual influence is the most important factor; the anatomical arrangement of the left spermatic vein and perhaps an hereditary influence play some part.

The condition develops slowly and affects the left side in practically all of the cases, may occur bilaterally, but rarely on the right side alone. It occurs most frequently during the age of greatest sexual potentiality (90 per cent between fifteen and thirty-five years in Campbell's series) and commonly disappears or causes no inconvenience after marriage, or with advancing years. These common observations are the basis for the belief that the congestion attending ungratified sexual desire and perhaps, in some cases, overindulgence are responsible for the condition in the majority of patients.

Theoretically the left sided preponderance has been explained on the basis of the anatomical variations in the right and left spermatic veins and on the common observation that the left testicle hangs lower than the right.

Some consideration has been given to the influence of heredity as a factor in the cause of varicocele. Barney believes that it has some connection, other authorities doubt this.

Violent muscular effort may produce acute varicocele by damage to the valves in the veins. Campbell recognized the condition 3 times in his series. It may be extremely painful and mimic acute epididymitis.

The pampiniform plexus is composed of three groups of veins, a posterior cremasteric, a middle deferential and an anterior spermatic group. Any or all of these veins may be involved in a varicocele, usually it is the larger spermatic group.

The condition is characterized by tortuosity and dilatation occurring primarily, later endophlebitis, thickening, fatty infiltration, thrombosis and phlebolith formation in some cases. The blood supply of the testicle may become so impaired by these changes that atrophy develops (about 1 per cent, Campbell; 11.5 per cent, Barney).

There is a great variety of subjective complaints presented by those affected with varicocele; a dragging sensation with or without pain is common. Many state that the condition is worse in hot weather or on exertion. A fear of impotence is present in many cases together with a variety of subjective symptoms that we usually associate with sexual neurasthenia. A large percentage have no symptoms.

The diagnosis of idiopathic varicocele is usually obvious on inspection, the dilated tortuous veins and a relaxed scrotum with low hanging left testicle are characteristic. The veins empty rapidly in the recumbent posture and refill promptly on standing. Omental hernia may possibly be mistaken for varicocele on inspection alone but is easily differentiated by first reducing the mass in the recumbent posture and retaining it within the abdomen with a finger pressed over the external ring while the patient stands.

The "bag of worms" felt on palpation is characteristic of varicocele. The condition may be associated with hernia (40 times in Campbell's series) or hydrocele, but this should offer no difficulty in differentiation.

Idiopathic varicocele is asymptomatic in the majority of cases and it is a common observation that symptoms disappear, and the varicocele as well, with marriage or when sexual activity begins to decline.

The condition may be divided roughly into three groups with reference to treatment, (1) the asymptomatic in which no treatment is required; (2) those with scrotal enlargement who complain of a feeling of weight or a dragging sensation in the scrotum or referred elsewhere. A suspensory should be tried. If this fails to bring relief, operation is indicated. (3) Those with sexual neuroses, and a small varicocele with or without symptoms referable to it. Operation is not advised in this group. These patients benefit in proportion to the confidence that their medical adviser is

able to instil in them. They must be told the facts. A sympathetic attitude, patience and time will affect a cure.

With this grouping used as a criterion, we operate upon comparatively few varicoceles.

The operation may be successfully performed under local anesthesia with slight inconvenience to the patient. Most of our patients choose some inhalation anesthetic, however. We prefer a combined inguinal and scrotal incision. The cord is exposed, the anterior group of vessels isolated and a section removed from them. Double ligatures are applied to both stumps after gentle crushing. Due care must be exercised in preserving the deferential circulation. We sometimes sew the cut ends of the stumps together with fine catgut but more generally employ the method of suspending the testicle devised by Vincent and described by Keyes in his textbook. We have not found abbreviation of the scrotum necessary, it usually becomes less redundant after operation. We do not employ drainage postoperatively.

The most serious complication is hemorrhage. We have not encountered it. Various observers have found that hydrocele follows operation in 23 to 30 per cent of cases. We have no figures on our cases but do not believe that it will even approximate such figures. Some have advocated eversion of the tunica vaginalis at the time the varicocele is attacked, but we do not agree that this is necessary or desirable. Atrophy occasionally occurs following operation. Its cause is not known but one always wonders about the preservation of the testicular circulation where it occurs. Campbell noted atrophy 3 times in 43 followed cases, while Douglas encountered it only 4 times in a followed series of 116 cases. Infection may occur and is quite likely to if there is secondary hemorrhage. Acute epididymitis occasionally follows operation.

A firm scrotal bandage is desirable postoperatively and a suspensory should be worn for a period of two weeks. Confinement to bed is required for five to seven days postoperatively.

Injection of the anterior group of veins after exposing and doubly ligating them has been advocated. It is claimed that the resulting fibrous cord makes a good suspension for the testicle. I have had no experience with the method, but it does not seem to me to be a rational procedure.

SUMMARY

Since the introduction of the newer types of sclerosing solutions in the injection treatment of hydrocele, it is now a practical procedure with definite advantages over radical surgical treatment in some instances. The procedure will affect a cure in a high percentage of cases and causes very slight inconvenience to the patient. We prefer radical surgery in the usual case, reserving injection treatment where the circumstances seem to justify its use.

We cannot see any advantage in the injection treatment of varicocele. A relatively small proportion of varicoceles requires operative treatment. In those cases in which operation is indicated, the results are as a rule satisfactory.

REFERENCES

Baretz, L. H. *Med. Times and Long Island Med. Jour.*, 63: 9–14 (Jan.) 1935.
Barney, J. D. *Pub. Mass. Gen. Hosp.*, 3: 335, 1910.
Campbell, M. F. *Surg. Gynec. and Obst.*, 45: 192–200, 1927.
Campbell, M. F. *Surg. Gynec. and Obst.*, 47: 4, 1928.
Eisendrath and Rolnick. Text Book of Urology. Phila., Lippincott Co.
Ewell, Sargent and Marquart. *Wisconsin Med. Jour.*, 34: 451–456, 1935.
Henninger, H. *Urol. and Cutan. Rev.*, 38: 1934.
Hinman, Frank. Principles and Practice of Urology. Phila., W. B. Saunders Co., 1935.
Keitzer, W. A. *Jour. Mich. State Med. Soc.*, 35: 1689 (March) 1936.
Keyes, E. L. Urology. New York, D. Appleton & Co., 1928.
Kilbourne, N. J. and Murray, Chas. J. *California and West. Med.*, 37: 1932.
Lubowa, Irwin. *Med. Rec.*, 143: 490–491 (June) 1936.
Nelson's Surgery. New York, Thos. Nelson & Son.
Floyd, E. and Pittman, J. L. *Jour. Med. Assn. Georgia*, 23: 63–66, 1934.
Rolnick, H. C. *S. Clin. N. Am.*, 15: 757–766, 1935.
Solley, F. W. *S. Clin. N. Am.*, 16: 867–870 (June) 1936.
Tanzer, Radford C. *Jour. Urol.*, 34: 447–452, 1935.

VAS DEFERENS: OPERATIVE TREATMENT

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SURGICAL procedures performed upon the vasa deferentia may be classified as follows: (1) for eradicating infection; (2) to prevent infection; (3) for relief of sterility; (4) for sterilization and (5) for injuries and neoplasms. It necessarily follows that frequently other parts of the seminal tract are involved and will be mentioned when necessary.

PROCEDURES FOR ERADICATING INFECTION

Vasostomy. This was first described by Belfield in 1905 as a method of treating infections of the spermatic tract, especially the vesicles, with antiseptics. His original operation was done under local anesthesia, the skin incision being made at the upper end of the scrotum, the vas identified, its sheath incised, the vas isolated for 2 to 3 cm. and its lumen opened by a small longitudinal incision. Patency of its lumen was next determined by passage of a horsehair, which in an unobstructed vas should pass about 20 cm. If the vas was unobstructed, either a blunt needle or a cannula was inserted into the lumen, left in place, and 3 to 6 mils of collargol was slowly injected, as it was found extremely irritating to the interstitial tissues. At a later date the original operation was modified and the vas opening was anchored to the skin with a horsehair in situ as a guide. Irrigations were given once or twice daily from one to several weeks. The procedure was taken up by many others and the various inorganic and organic silver, as well as mercurial preparations, were used. Later Belfield tested patency with a 1:25,000 solution of methylene blue, which in a short time appeared in the urine.

Various modifications of Belfield's operation appeared, most notable of which were Kidd's and Luys'. These modifications were brought out in an attempt to overcome the marked interstitial reaction due to reverse flow of the chemical, its accompanying cicatricial formation and resultant sterility. Kidd's modification consisted of making a minute opening into the lumen of the vas with a small tenotome. After proving the patency of the vas with fine silkworm gut, the exposed vas and surrounding tissues were well protected by gauze. A No. 20 gauge needle with a tight fitting syringe was inserted into the lumen and 5 to 10 mils of colloid silver was injected. The opening into the vas was closed with one or more fine 00 catgut sutures through its outer layers, the vas replaced and the skin was closed by catgut sutures. Usually one injection was sufficient. Where necessary a second injection was given one week later by opening the vas at a higher level. In Luys' operation of vasopuncture the vas was opened with a fine pointed trocar and cannula. Through the latter patency was tested and the injection then made. Belfield, Barney and others used the vasostomy procedure as a means of injecting opaque material for roentgenological studies of the vasa and seminal vesicles. Later this was replaced by catheterization of the ejaculatory ducts and direct injection of the opaque medium (sodium iodide and skiodan) into the vesicles.

Much work was done along this line of treatment from the time of Belfield's original report in 1905, particularly where the main focus was found or thought to be in the seminal vesicles and resulting in recurring epididymitis, arthritis and recurring urethritis, until around 1925. While

certain investigators worked along this plan of treatment, others believed the more rational plan was to perform either seminal vesiculotomy or vesiculectomy. Selected cases for vasostomy were reported as giving 50 per cent cures, however, the procedure has lost a good deal of its earlier popularity. At the Squier Urological Clinic from 1928 to date only 2 vasostomies were performed, no seminal vesiculectomy for an infectious process and only 11 seminal vesiculotomy operations for suppuration were performed.

The vas deferens may be infected by extension along its wall or sheath. The vas may become infected from the epididymis or the seminal vesicles. Infections likewise may travel from the seminal vesicle through the lumen of the vas to the epididymis or vice versa without clinical evidence of involvement of the vas. Frequently in severe epididymitis the wall of the vas into the inguinal region is involved by continuity. Anatomically the sheath of the intrascrotal and intrapelvic portions of the vas merge into loose connective tissue at the level of the internal inguinal ring (Bogros's space). Seminal vesicle infections travelling along the sheath of the vas may give rise to tender indurated swellings or abscesses. The former may be confused with incarcerated inguinal hernia. Occasionally these sheaths of the vas are continuous and infections extending along the sheath enter the tunica vaginalis. When infections extend along the sheath all structures of the spermatic cord become involved and this is classified under funiculitis. Vasitis or deferentitis is most frequently associated with gonorrheal or other types of epididymitis and in these cases the entire wall of the vas is thickened. Where abscess is present incision and drainage is performed; where in doubt the condition is to be observed. When there is no question of abscess, bed rest and ice bags or diathermy may be indicated. In addition to treatment directed to the vas other involved parts should receive appropriate care.

PROCEDURES TO PREVENT INFECTION

In the nineteenth century ligation of the vas as well as castration was employed unsuccessfully as a means of overcoming prostatic hypertrophy by such workers as Cowper, Curling, Pasteau, Pousson, Albarran and Guyon. Squier in an article on prostatectomy in the Medical News, February, 1905, suggested vasectomy as a prevention of epididymitis and is quoted herewith:

> We offer as a suggestion for the prevention of this complication ligation of the vasa deferentia prior to performing prostatectomy. It is but the work of a moment and would not materially prolong time of the operation. When severe cystitis exists it may prove especially efficacious, as these are the cases in which epididymitis is most prone to occur.
>
> Proust makes a point of isolating and ligating the ejaculatory ducts before the removal of the prostate. It no doubt acts the same as ligation of the vasa, but requires more time to do as well as an elaborate dissection. We do not recommend that ligation of the vasa deferentia should be a routine procedure, but it may be found to be advantageous where the debility of the patient is so great that the possibility of testicular inflammation would greatly affect the prognosis.

In the latter part of the nineteen-twenties this suggestion first received considerable attention from Colston, Goldstein, Alyea, Crabtree, Brodny, Abeshouse and others. Today it is very commonly employed before even instituting preparatory treatment for prostatectomy or transurethral prostatic surgery.

These operations are variously termed as ligation of the vas, vasoligature, vasectomy and division of the vas and are performed to prevent infection that might extend through the vas, its sheath or lymphatics (?) from the prostate, its fossa, or the seminal vesicles to the epididymis and testicle or in the reverse manner. The more common method employed consists of an excision of a small segment, about 2 to 3 cm. The procedure can be readily carried out under local anesthesia. The vas is

grasped between the thumb and index or middle finger at the level of the incision, which is usually made on the anterior surface of the scrotum just below the scroto-abdominal junction. The vas is separated from other contents of the cord and ligated in two places, a small segment of 2 to 3 cm. is excised, the stumps replaced and the skin closed with two to three interrupted sutures without drainage.

The value of vasectomy as a preliminary to prostatectomy, transurethral prostatic operations and other protracted bladder operations can readily be seen by the following reported figures: Crabtree and Brodny in 1930 collected 1624 reported cases of prostatectomy without previous vasectomy, 21.6 per cent of which developed epididymitis, while in 514 cases in which vasectomy was performed, only 8 cases of epididymitis developed, or a percentage of 1.50. In 1936 Abeshouse reported 208 cases of prostatectomy with preliminary vasectomy without a single case of epididymitis. Recently the author reviewed the cases at the Squier Clinic from 1931 to 1935 inclusive, 414 cases of prostatectomy without vasectomy developed 49 cases of epididymitis, 5 of which required incision and drainage, making a percentage of 11.8 of epididymitis, 10.2 per cent of the latter requiring incision and drainage. During the same time 187 cases of prostatectomy had vasectomy performed and developed only 9 cases of epididymitis, 4 of which, however, required incision and drainage. This makes a percentage of 4.81 of epididymitis, 44.4 per cent of which required incision and drainage. At the Squier Clinic we believe vasectomy should be employed early in the course of preparation for prostatectomy or otherwise it may light up a pre-existing focus which may go on to suppuration. The variation in the percentages of epididymitis with or without vasectomy vary directly with economic factors. Private patients show the least involvement. Ward patients in a city or state hospital give the highest percentage of epididymitis.

Various other operations have been described by Alyea, Colston, Morson, Darget, Labot and others. Alyea and Colston, using special clamps and needles, ligate the vas through the scrotum without making an incision. Morson instead of ligating the surgically exposed ends of the vas crushes them between artery clamps. Darget and Labot employ a single anterior vertical midline incision along the median raphe of the scrotum for exposure and division of the vasa.

While primary tuberculous involvement of the vas apparently does not occur, it is secondarily involved from the epididymis and seminal vesicles. It is not in the scope of the paper to bring up factors for or against where the primary focus of tuberculosis in the lower genitourinary tract occurs. Radical removal of the entire lower genitourinary tract seems to have lost much of its prestige. To-day, however, it is common practice in removing a tuberculous epididymis to do a vasectomy on the uninvolved side, even in the absence of proved involvement of the prostate or seminal vesicles. Vasectomy is also done bilaterally in cases of proved prostatic or seminal vesicle involvement, without definite evidence of invasion of the epididymis. Barney has shown that these cases of tuberculosis are usually sterile.

FOR RELIEF OF STERILITY

These operations have been devised to overcome mechanical obstructions which prevent the passage of spermatozoa from the testicle or epididymis through the vas to the ampulla and vesicle. In azoospermia the condition is either bilateral or unilateral with the opposite side absent or atrophied. The operations described consist of anastomosis between the vas and epididymis, between the vas and testicle, between the vas and a spermatocele and crossed anastomosis of one vas to the opposite epididymis or testicle. Success, in addition to the operative technique, depends on proving the patency of the vas deferens above the obstruction as well as finding viable

spermatozoa in either the epididymis or testicle below the obstruction. Failures from the operative standpoint are not only due to the very small calibre of the lumen of the vas and the brittleness of epididymal tubule, but also to the fact that hemorrhage, tension of suture and infections can easily give rise to sufficient scar tissue to obstruct the new passageway. It is important also to know the status of the ampulla and seminal vesicle.

In 1902 Martin and his associates described the first laterolateral anastomosis of the vas to the epididymis. This was followed by modifications by a number of men such as Fuller, McKenna, Lespinasse, Quinby, Bogoljuboff, Hagner and others. Fine silk, silkworm gut, silver wire with occasional addition of catgut are the favorite suture materials. Direct anastomosis of the vas to the epididymis is almost impossible because of the microscopic size of the tubule of the epididymis. Because of the latter the vaso-epididymostomy operations require removal of an oval or cup-shaped piece of tubule and thereby hoping the anastomosis will develop from one of the convolutions.

Hagner's Operation. Hagner exposes the entire epididymis by opening the tunica vaginalis. He tests the patency of the vas with a fine tear duct probe, which should pass 16 to 20 cm. At a point in the epididymis where viable spermatozoa are obtained an elliptical piece is excised and laterolateral anastomosis is made with fine silver wire. The first silver wire suture is used for anchorage and is placed between the distal end of the opening into the vas and the lower end of the elliptical incision. Two lateral sutures are used and care should be exercised to include some of the cut tubules of the epididymis and prevent their dropping back. These sutures should include just enough of the opening into the vas to approximate the edges of the anastomosis. In placing the last suture, which approximates the upper ends of the incision in the epididymis and the vas, one should be careful not to occlude the lumen. Before this suture is tied patency should be tested with the fine tear duct probe. From Hagner's experience manifestations of successful operations vary up to nine months, and, therefore, he waits one year before undertaking a second anastomosis. He has had good end results in 21 of 33 cases operated or in 63.6 per cent.

Anastomosis of Vas Deferens to Spermatocele. Spermatoceles are common and may be present with occlusion of the epididymis. Lateral anastomosis or direct implantation of the cut end of the vas into the spermatocele sac offers excellent chance of success. Hagner reported a successful lateral anastomosis of this type, which six weeks postoperatively had live spermatozoa, and his wife gave birth to a child within one year.

Crossed Anastomosis of Vas. Hagner reported this type of anastomosis in 3 cases in which viable spermatozoa were found in the epididymis but the corresponding vas was occluded, while the opposite vas was patent but without spermatozoa in its epididymis. In these cases the patent vas is severed at the lowest feasible point and passed through the median septum of the scrotum and anastomosed to the epididymis.

Anastomosis of the Vas to the Rete Testis. This type of anastomosis was unsuccessfully attempted and reported by Scaduto in 1901. The first successful ones were reported by Bogolojuboff in 1903. The original operation was modified by Rolnick on the basis of experiments on dogs. In Rolnick's operation the vas is lifted out of its sheath 1½ inches above the point it crosses the mediastinum of the testicle. A small longitudinal incision is made in the vas and its patency tested. A blunt vasotomy needle is then inserted through this opening downward toward the epididymis and the vas is divided over the needle where it crosses the mediastinum of the testicle. The upper end of the vas is split into two or three parts and 000 catgut sutures inserted through the split ends with a No. 23 gauge hypodermic needle. The

vasotomy needle in the vas is threaded with a fine silkworm and then removed. A long No. 23 gauge hypodermic needle is inserted through the posterior convex surface of the testicle with its point emerging at the rete in the mediastinum. At this point of emergence the tunica is split for a distance of ¼ of an inch, the rete incised and tested for spermatozoa. The needle through the testicle is threaded with the same silkworm which has passed through the lumen of the vas and withdrawn, so that the silkworm now passes through the testicle and vas. The sutures in the split end of the vas are united to the tunica of the testicle which has been incised, the ends of the vas dipped into the rete and the sutures tied. The silkworm is carried out on the skin on both sides and then tied. It is left in place seven to ten days. The purpose of this silkworm gut is to develop a channel, prevent organization of a scar, make a path for the process of epithelialization and to fix the testicle and vas and thus avoid tension. The introduction of the silkworm gut suture for these purposes was first brought out by McKenna in his work on epididymovasostomy.

Wilhelm in 1935 has suggested and described a two-stage vaso-orchidostomy with interposed spermatocele.

OPERATIONS FOR STERILIZATION

The subject of sterilization has gained increased prominence through legislation not only in several European countries but also in states in this country. The compulsory aspects of these legislations apply usually to the physically and mentally defective public charges, as well as all persons with outward evidence of hereditary disease. It is well to remember that, dependent on the circumstances, consent for human sterilization may be given by the patient, by the patient with his parents or guardian, may be ordered by state officials and that it may be forbidden by law, as four states limit by penal statutes sterilization in private practice to cases of "medical necessity." Twenty-eight states have laws providing compulsory or voluntary sterilization of mentally deficient persons. Whenever the question of sterilization arises in marriage because of a pathological condition it would seem more logical to sterilize the so afflicted individual. The latter opinion at times may have to be varied after consultation with the internist. The question of sterilization of a healthy male is, however, a problem of his own to be discussed with his physician.

The operations performed for sterilization have been described under procedures to prevent infection. Whenever this operation is performed for sterilization it is highly advisable to excise 4 to 6 cm. of each vas, appropriately label the section from either side and request a histological section of the same. Another caution is, that the semen should be checked at intervals for spermatozoa, as they can at times remain viable within the vesicles for lengthy periods. Wildenskov advocates injection of a sterilizing agent such as 0.1 per cent rivanol, into the vas above the resection. Steinbach in 1912 advocated vasectomy for impotency in the elderly male, claiming it caused proliferation of the interstitial cells, with an increased production of the male hormone. This to date has not been proved and has been widely criticized.

OPERATIONS FOR INJURIES AND NEOPLASMS

Injuries of the vasa are not at all common. Injuries more likely to occur are those due to accidents in operations involving the spermatic cord where the vas may be partially or completely severed. When recognized the partially or completely severed vas should be immediately repaired by two or more fine silk or silver wire sutures, care being taken not to include the lumen. Another method of suturing frequently employed is to pass a piece of fine silkworm gut threaded to a needle into the lumen of both ends of the vas and out through the wall for a distance of 1 cm. Having thus approximated the divided vas, the ends of the suture are tied loosely

over the skin and after seven to ten days are cut and removed. The sheath of the vas should always, if possible, be reunited. Other operative injuries are those following the use of strong chemicals in vasostomy procedures. Infrequent injuries occur in stab wounds, bullet wounds and blows. In the latter, injuries to the blood vessels are more likely to occur than to the vas itself and the treatment is similar to wounds in general.

Neoplasms of the vas deferens are extremely rare. Cysts such as spermatoceles occasionally occur. Fibroma is occasionally seen and more likely arises from the spermatic cord. A few cases of lipoma and one of scarcoma have been reported. Other malignancies along the course of the vas are usually extensions from primary growths from within the scrotum. The operative treatment in benign growths is local excision and in malignancies dependent on the degree of involvement either radical surgery, deep *x*-ray therapy or a combination of both.

SUMMARY

Vasostomy, like seminal vesiculotomy and seminal vesiculectomy were popular operative procedures from 1905 through 1925. Since then they have lost a great deal of their popularity with resultant greater selectivity of cases.

The most common operation on the vas deferens, ligation of the vas, is mainly employed preliminary to prostatectomy, whether performed by the open or closed methods, and preliminary to extensive bladder or urethral manipulations, as a preventative to epididymitis. It is also employed in cases of tuberculosis where the prostate, seminal vesicle or one epididymis is involved, hoping to prevent spread to the uninvolved epididymis. Ligation of the vas is employed in sterilization of the male.

Operations for the relief of sterility have to overcome the mechanical obstructions which prevent the spermatozoa from traveling from the testicle and epididymis through the vas to the ampulla and vesicle, which necessarily have to be varied, dependent upon operative findings in each case.

Neoplasms benign or malignant of the vas deferens are rare and seldom primary. Likewise injuries are uncommon.

REFERENCES

Abeshouse, B. S. *Am. Jour. Surg.*, 32: 8–16, 1936.
Alyea, E. B. *Jour. Urol.*, 19: 65, 1928.
Barney, J. D. *Tr. Am. Assn. Genito-Urinary Surg.*, 9: 72, 1914.
Barney, J. D. *Am. Jour. Surg.*, 28: 471, 1914.
Belfield, W. T. *J. A. M. A.*, 44: 1277, 1905; 61: 1867, 1913; 74: 148, 1920; *Jour. Urol.*, 14: 349, 1925.
Belfield, W. T. and Rolnick, H. C. *J. A. M. A.*, 1913; *Jour. Urol.*, 16: 73, 1926.
Belt, E. *J. A. M. A.*, 102: 396, 1934.
Bogoljuboff, V. *Semaine Medicale*, 1924; Mett. I and II. *Arch. f. Klin. Chir.*, 70: H. 3, 1902; 72: 449.
Colston, J. A. C. *J. A. M. A.*, 90: 526, 1928.
Crabtree, E. G. and Brodny, M. L. *Tr. Am. Genito-Urinary Surg.*, 23: 383, 1930.
Darget, R. and Labot, P. *Bull. Soc. franç. d'urol.*, p. 234, 1933.
Fuller, E. *Jour. Cutan. and Genito-Urin. Dis.*, 14: 329, 1896; *Med. Rec.*, p. 717, 1909.
Goldstein, A. E. *Jour. Urol.*, 12: 25, 1927.
Hagner, F. R. *Surg. Gynec. and Obst.*, 52: 330, 1931; *J. A. M. A.*, 107: 1851, 1936.
Kidd, F. S. *Lancet*, 2: 213, 1923; 2: 28, 1928.
Lespinasse, V. D. *J. A. M. A.*, 70: 448, 1918.
Luys, G. *Clinique, Paris*, 8: 34, 1913; *Cong. d'urol.*, 1921; Paris, G. Doin et Cie., 1930.
Martin, Carnett, Levi and Pennington. *Univ. Penn. Med. Bull.*, 15: 2, 1902.
McKenna, C. M. *J. A. M. A.*, 64: 2127, 1915.
Morson, A. C. *Brit. Med. Jour.*, 1: 54–55, 1933.
Quinby, W. C. *Boston Med. and Surg. Jour.*, 155: 539, 1906.
Randall, A. *Jour. Urol.*, 16: 141, 1926.
Rolnick, H. C. *Jour. Urol.*, 12: 445, 1924; 14: 371, 1925.
Squier, J. B. *Med. News*, 86: 294, 1905; *Boston Med. and Surg. Jour.*, 170: 908, 1914; *New York Med. Jour.*, 101: 333, 1915.
Wildenskov. *Ugesk f. Laeger.*, 98: 104, 1936.
Wilhelm. *Arch. Surg.*, 30: 967, 1935.

OFFICE TREATMENT OF BARTHOLIN'S GLAND ABSCESS OR CYST

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BARTHOLIN'S gland abscess or cyst can be treated satisfactorily in one's office with a minimum of expense and discomfort to the patient. I have used the procedures described here for six years and have found them to be simple, safe and curative.

FIG. 1. The gland is held firmly between the thumb and the index finger. An incision, about 1 cm. long, is made through the skin in the dependent portion of the mass in the region of the duct. In case of abscess of Bartholin's gland, the incision is made in the same place, but it is made a little bit longer and extends into the gland itself. When the pus is evacuated, a small gauze strip is inserted to keep the incision from closing prematurely.

FIG. 2. The heated blade of a Post cautery is thrust through the opening in the gland, and the lining of the gland is destroyed by vertical and horizontal movements with the blade tip.

BARTHOLIN'S GLAND ABSCESS

The red, painful and fluctuating swelling in the region of the Bartholin's glands is diagnostic of Bartholin's gland abscess. There is only one treatment for this condition, incision and drainage.

Under local ethyl chloride anesthesia the incision is made at the dependent portion of the gland, near the mucocutaneous border. The abscess should not be squeezed or massaged after the incision has been

made. A small gauze strip is then inserted into the opening, and it is replaced with a clean one every other day for three or four times. This insures adequate drainage and prevents the incision from closing too early.

Fig. 3. The wound one week after the cauterization. Drainage continues through this opening and the healing takes place from the base of the wound. In one month or less the wound is healed.

The physician must know that this is merely an emergency treatment and that when the wound has healed, if the duct of the gland does not reopen, the continued function of the gland may lead to the formation of a cyst. He should inform the patient of this, and instruct her to return for removal of the cyst if one should form and cause her inconvenience. He should also tell the patient that there are two Bartholin's glands.

BARTHOLIN'S GLAND CYST

In many cases of Bartholin's gland abscess the gland and its duct are destroyed, and following incision and drainage there is a permanent cure. However, in many cases the mucous membrane lining of the gland does not lose its ability to secrete mucus, and if the duct remains closed there will ensue a Bartholin's gland cyst which will slowly enlarge to the point of producing great inconvenience.

Bartholin's gland cyst is treated in the following manner: Under intravenous evipal or pentothal sodium, or under nitrous oxide or ethylene anesthesia, after aseptic and antiseptic precautions, the cyst is grasped between two fingers and an incision, approximately 1 cm. in length, is made through the skin, as near the duct opening as possible (Fig. 1). Through this incision the hot blade of a Post cautery is inserted into the cyst, and, then, by a series of vertical and lateral strokes, the entire wall of the cyst is destroyed by actual cautery (Fig. 2). If the incision is made close enough to the opening of the duct, the duct will also be destroyed. No packing is necessary as the cauterized edges of the incision will remain open until the entire site of the cauterization has healed. There is no bleeding and only slight discomfort following this procedure. The entire operation can be done in about three minutes, and within two or three hours the patient is able to get up and walk home.

The wound heals slowly by granulation from its base, and in one week has the appearance shown in Figure 3. During this time there is practically no discomfort to the patient. At the end of one month the wound is closed and healed with a hardly perceptible scar.

SUMMARY

An office method of treating Bartholin's gland abscess and Bartholin's gland cyst is shown. The cyst lining is destroyed by means of the Post cautery through a small incision, and illustrations are given to demonstrate the method.

IMPERFORATE HYMEN*

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IMPERFORATE hymen is a malformation of real clinical importance even though it is not very common. Nelson,[1] in his report of a case of congenital atresia due to imperforate hymen, refers to the 36 collected cases reported by Ross in the American Medical Journal of July, 1891, which reviewed the literature up to that time. Murphy in the British Medical Journal reported one case in 1895. A survey of the literature from 1916 to 1936 reveals 37 reported cases.

ANATOMY

The hymen is a thin membraneous fold partially closing the lower end of the vagina, separating the vagina from the vulva, and is perforated usually at the center. The structure of the hymen is similar to that of the vagina and is composed of connective tissue with numerous elastic fibers, blood vessels, occasional nerve endings, and is covered on either side with stratified epithelium. The opening in the hymen varies in size and shape, giving rise to different types depending on the pattern of the opening. The more common types are: the semilunaris, the annularis, the cribiform, the septate, the denticulata or fimbriata and the imperforate. These are self-explanatory. The fimbriated hymen may sometimes be mistaken for a ruptured hymen and possesses some medicolegal interest.

In the newborn the hymen is redundant and projects beyond the surrounding parts. In the adult virgin the margins of the opening are usually in contact with each other, closing the aperture in the vagina, more or less completely. The size of the orifice varies from a pinhead to a caliber which will readily admit the tip of one finger.

The consistency of the hymen is gynecologically important from the standpoint of coitus, dyspareunia, and relative sterility. It may be so firm and rigid that surgical interference may be necessary before coitus can be comfortably accomplished, or it may be very elastic so that no rupture takes place with coitus. Boynton[2] reported a case of pregnancy with an unruptured hymen in an unmarried girl; an Aschheim-Zondek test aided in the differential diagnosis from an ovarian cyst. Contrary to popular lay belief, loss of virginity is not always associated with loss of blood although in very rare instances the loss of blood may be so profuse, as to require surgical treatment.

Cases have been reported in which an almost imperforate hymen had remained intact until labor and ruptured only when distended by the head of the fetus or had to be incised to avoid irregular lacerations. This also obtains in patients having a thick septate hymen, where the bridge of tissue has to be cut before delivery can be accomplished. I saw a case of the latter during my internship days on the Gynecological and Obstetrical Service at the Carney Hospital. Papadopoulos[3] reported a case of ectopic gestation with an apparently imperforate hymen.

EMBRYOLOGY

The cephalic portions of the Mullerian ducts become the Fallopian tubes and the fused caudal parts of the Mullerian ducts give rise to the uterus and vagina.

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According to Cunningham[4] the hymen is formed from a little fold which appears at the point where the vaginal portion of the

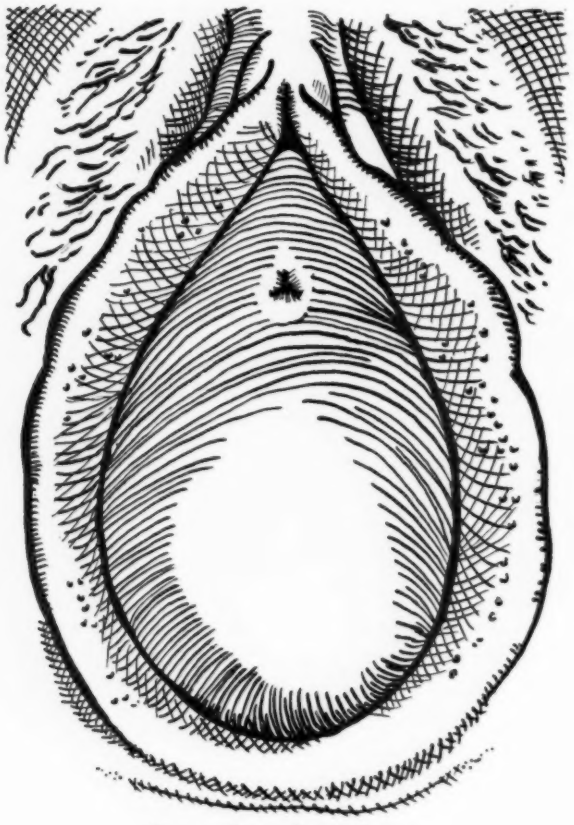

Fig. 1. Imperforate hymen.

fused Mullerian ducts opens into the urogenital canal. He also refers to the direct continuity of the upper surface of the hymen with the vaginal wall and the similarity in structure, concluding that the hymen is a portion of the vagina, from the viewpoint of development.

Williams[5] refers to the embryological researches of Nagel, which have been confirmed by Gellhorn, holding the point of view that the hymen represents the lowest portion of the vagina. He further states: "In early embryos the hymen is composed of a solid mass of epithelial cells and after proliferating rapidly for a time, those most centrally situated begin to degenerate so that a lumen is produced." Imperforate hymen is produced by the persistence of the centrally located epithelial cells of the posterior wall of the urogenital sinus, which normally degenerate to produce a lumen which becomes the vaginal outlet.

The late C. Jeff Miller[6] advanced two other possibilities as to the causation of imperforate hymen, in addition to the one stated which is the most generally accepted, namely: (1) some infection in intrauterine life; and (2) excessive proliferation and coalescence of the area just back of the septum, rather than its failure to regress.

COURSE

Imperforate hymen is rarely recognized before puberty because of the absence of symptoms before the onset of the menses. It may be detected before puberty only when other conditions at the vulva direct attention to this region. After puberty the normal outflow of menstrual blood and mucus secretion is obstructed by the atresia and cannot escape from the vagina. This is followed by an accumulation of menstrual fluid above the obstruction producing hematocolpos first; later when the vagina has been completely filled and distended with menstrual blood, the cervix begins to dilate and becomes filled with blood producing hematotrachelos, and when the uterus in turn is filled with blood we have hematometra. The menstrual fluid then forces its way out into the tubes and the peritoneal cavity. Some of the viable endometrial cells[7] which are present in the menstrual flow, may be implanted on the ovary or peritoneum and produce endometriosis. This continued irritation of the menstrual fluid, produces a chemical peritonitis. Adhesions are soon formed which seal the abdominal ends of the tubes. Then with no further avenue of escape, the blood distends the tubes and we have a condition of hematosalpinx.

COMPLICATIONS

If not corrected in time serious consequences may follow. The two principal dangers are rupture and infection. Spontaneous rupture may occur externally or internally.

In external rupture the hymen usually gives way. This is sometimes followed by recovery, but more often the distended toneal cavity. Gerin-Lajoie,[9] reported a case of generalized peritonitis caused by an imperforate hymen.

Fig. 2. Imperforate hymen first causes distention of the vagina producing hematocolpos. (*After Sulton and Giles.*)

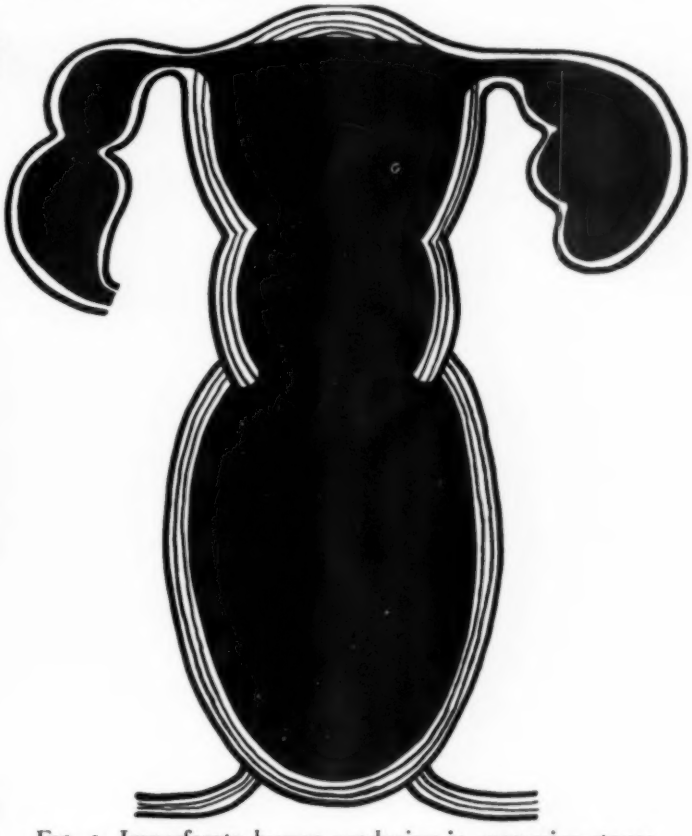

Fig. 3. Imperforate hymen producing in successive stages, hematocolpos, hematotrachelos, hematometra and hematosalpinx. One tube is shown open, while the other shows the abdominal ostium sealed as a result of chemical peritonitis. (*After Sulton and Giles.*)

cavity becomes infected. Cases have been reported of perforation through the labium majus.[8]

In internal rupture the vaginal, uterine, or tubal walls may be perforated. A vesicovaginal or rectovaginal fistula[8] may be produced and the blood may be discharged through the bladder or rectum. These spontaneous openings are usually inadequate and recurrence of the original condition usually takes place, or a permanent fistula is produced. The most serious complication is an intra-abdominal rupture of hematosalpinx with subsequent peritonitis.

Hematocolpos may become infected by invasion with colon bacilli, producing a retention sepsis which may spread upwards and involve the uterus, tubes and peri-

SYMPTOMS

There may be no symptoms complained of by the patient at the onset even when the girl is at the age of puberty, and is menstruating internally. In such a case, obviously the diagnosis cannot be made, unless we are fortunate enough to have the privilege of examining the patient, with the idea of determining whether or not an imperforate hymen is present, as was the case with McIllroy and Ward.[10] They reported 3 cases of imperforate hymen occurring in one family:

The eldest sister, aged twenty years, had never menstruated, and complained of attacks of abdominal pain occurring monthly, for the past six months. She also noticed that her abdomen was increasing in size. Examination

revealed an imperforate hymen with hematocolpos and hematometra. The hymen was excised and she made an uneventful recovery and menstruated normally afterwards.

Exactly one year later, another sister, aged sixteen years, gave an identical history, also of six months duration. Examination revealed a condition similar to that of her sister. Operation was performed with an uneventful convalescence.

The mother then volunteered the information that she has a third daughter who was fourteen years old and had never menstruated, but was symptom-free. The mother was advised to have her daughter come in to be examined. Examination showed an imperforate hymen, but there was no evidence of hematocolpos. An operation was advised and when the hymen was excised two pints of chocolate colored fluid flowed out. Menstruation has been normal since the operation.

Usually however, the patient is at the age of puberty, has menstrual molimen, but does not have an external flow of blood. There is pelvic distress and discomfort, which increases from month to month. Sometimes the pain is very severe and sharp,[11] and is followed by pelvic fullness and pressure, with a general feeling of lassitude. There may be rectal irritation producing a frequent desire for evacuation of the bowels, and vesical irritation producing frequency of urination. Snodgrass,[12] Lazarus,[13] Hammond,[14] and Mouradian[15] report cases of acute urinary retention due to mechanical compression and angulation of the urethra by hematocolpometra. Where acute urinary retention is the presenting symptom in patients at the age of puberty, who have never menstruated, we must not neglect to make a recto-abdominal examination, in spite of the reluctance of the patient, or else the diagnosis will be missed, valuable time will be lost and unnecessary cystoscopic studies and *x*-ray studies will be made before the correct diagnosis is reached, as happened in one of the cases reported by Lazarus.

EXAMINATION

In patients having an imperforate hymen, inspection reveals the lack of hymenal opening. There may be some bulging and slightly bluish discoloration of the hymenal membrane. Recto-abdominal examination reveals the presence of a soft, fluctuating tumor, which varies in size with the extent and duration of the condition.

Recto-abdominal examination should be performed in every patient at the age of puberty who does not menstruate and who has attacks of abdominal pain. Nelson[1] reported a case in which the abdominal examination suggested an acute surgical condition in the abdomen. A rectal examination was not done. A tentative diagnosis of acute appendicitis was made and at operation hematometra and hematosalpinx were found with dark colored fluid in the abdomen. The hymen was then inspected and found to be imperforated.

DIAGNOSIS

The diagnosis is easily made if a careful history is taken and a careful examination is made, including inspection of the hymen and recto-abdominal palpation.

TREATMENT

The treatment is surgical. The first principle to bear in mind is rigid asepsis throughout the operative and convalescent stages, because of the danger of infection. Under a general anesthetic a crucial incision is made and the fluid is allowed to escape slowly. Then the central area of the hymen is excised and the cut edges are sutured with fine catgut to control the bleeding. Mere incision, without excision of the central area of the hymen is not enough, as shown by the case reported by Nelson[1] in which the imperforate hymen was merely incised, the fluid allowed to drain out, and a rubber tube drain inserted. Four weeks later the incision in the hymen was closed and another operation had to be performed.

Irrigations are not advised because of the fear of spreading infection upward. If there is evidence of a tubal tumor, a laparotomy should be performed and a radical operation done removing all pathological organs.

The dangers of infection are too real to warrant conservatism in such cases. Drainage should always be instituted because these patients are potentially septic.

SUMMARY

Imperforate hymen is clinically important even though the condition is not very common. It is produced by the failure of the centrally located epithelial cells of the posterior wall of the urogenital sinus to degenerate.

When this condition obtains the menstrual blood is prevented from flowing out of the vagina and begins to back up, producing in order, hematocolpos, hematotrachelos, hematometra, hematosalpinx and sometimes endometriosis.

If imperforate hymen is neglected, complications may occur. These are produced either by rupture or infection.

We must think of imperforate hymen when a patient at the age of puberty does not menstruate and complains of pelvic distress, discomfort or pain, which increases in severity from month to month. Acute urinary retention may be the outstanding symptom.

Imperforate hymen is recognized by the lack of a hymenal opening on inspection, and the presence of a soft fluctuating tumor on recto-abdominal palpation. Recto-abdominal examination should not be neglected in these patients.

The treatment consists of making a crucial incision to allow the fluid to run out slowly, and then excising the central area of the hymen and suturing the cut edges.

The literature is reviewed.

REFERENCES

1. Nelson, M. S. Congenital atresia of vagina due to imperforate hymen. *Illinois Med. Jour.*, 53: 279–280 (April) 1928.
2. Boynton, R. E. Pregnancy with unruptured hymen. *Journal-Lancet*, 54: 646 (Oct. 15) 1934.
3. Popadopoulos, B. S. A case of ectopic gestation with an apparently imperforate hymen. *Lancet*, 1: 140 (Jan. 25) 1919.
4. Cunningham's Text Book of Anatomy, Ed. 5, edited by A. Robinson, New York, William Wood and Co., 1922.
5. Williams Text Book of Obstetrics. Ed. 5, New York, D. Appleton and Co., 1924.
6. Miller, C. Jeff in Davis' Gynecology and Obstetrics. Hagerstown, Md., W. F. Prior Co., 1935, Vol. 2, Ch. 8.
7. McGlinn, J. A. and Harer, W. B. Hematometra. *Am. Jour. Obst. and Gynec.*, 30: 704, 1935.
8. Stumdorf, A. Gynoplastic Technology, Ed. 2, Philadelphia, F. A. Davis Co., 1923.
9. Gerin-Lajoie, L. A case of imperforate hymen, cause of generalized peritonitis. *Union méd. du Canada*, 63: 468–472 (May) 1934.
10. McIllroy, L. and Ward, I. V. Three cases of imperforate hymen occuring in one family. *Proc. Roy. Soc. Med., Sec. Obst. and Gynec.*, 23: 13–14 (March) 1930.
11. Drosin, L. Imperforate hymen with anomalous anatomical union and position. *Med. Rec.*, 141: 530 (June 5) 1935.
12. Snodgrass, M. R. Acute urinary retention in female; case due to hematocolpometra. *J. A. M. A.*, 97: 777 (Sept. 12) 1931.
13. Lazarus, J. A. Acute urinary retention from vaginal occlusion, due to imperforate hymen, 2 cases. *New York State Jour. Med.*, 32: 339–340 (March 15) 1932.
14. Hammond, F. C. Imperforate hymen causing retention of urine. *Atlantic Med. Jour.*, 29: 690–691 (July) 1926.
15. Mouradian, A. H. Acute urinary retention due to hematocelpometra. *Med. Jour. and Rec.*, 135: 369–370 (April 20) 1932.

BIOPSY OF UTERINE CERVIX*

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ACCORDING to statistics, carcinoma of the uterus is said to account for approximately one-third of all malignant neoplasms in women. About 90 per cent of carcinomas of the uterus have their origin in the cervix, while the remaining 10 per cent arise from the endometrium. The uterine cervix has two types of epithelium, cylindrical epithelium, lining the cervical canal and squamous stratified epithelium, covering the vaginal portion. Malignant epithelial new growths of the cervix most frequently develop at the junction of the two epitheliums at the so-called mucocutaneous border. Because of the anatomical configuration of this organ, three main types of epithelial malignant disease may develop in the cervix; a true adenocarcinoma, from the cylindrical epithelium of the endocervix; an adenoacanthoma, a tumor composed of glandular and squamous elements, arising in the portio or cervical canal, and a squamous cell or epidermoid carcinoma from the stratified squamous epithelium of the portio. Primary sarcoma of the cervix is extremely rare; I have met it but once in a gynecologic experience of twenty-four years.

Chronic irritation is admittedly an important predisposing factor in the development of malignant disease of the cervix. Infection resulting in chronic inflammation and the trauma of childbirth, with superimposed infection and inflammation, play a conspicuous role in favoring the development of this condition.

The uterine cervix is readily accessible to palpation, inspection and treatment. For these reasons it would seem logical to expect better results than we are now obtaining if patients presented themselves earlier to their physicians. When the cause of carcinoma is discovered, the treatment may be entirely changed. For the present our strongest arms against the disease are (1) prophylaxis, (2) early diagnosis and (3) early treatment.

PROPHYLAXIS

If it is rightly assumed that chronic irritation is an important element in the production of malignant disease of the portio, it is logical to feel that the prophylaxis rests in removing all sources of irritation from that organ. There are no symptoms in early carcinoma of the cervix; the symptoms are slight and frequently overlooked in moderately advanced cases. Hence, the basic principle involved rests primarily on the periodic examination of all women during the period of sexual activity or childbearing age. Carcinoma of the cervix is known to occur at all ages, but it is most commonly encountered between the ages of forty and fifty years. After seventy years of age it is uncommon. The periodic examination will lead to the detection of irritative lesions and their eradication. It is worthy of emphasis that no obstetrician should discharge his patient after childbirth until her cervix is completely healed. Simple erosions may be treated in the office by linear cauterization, which may be done in one sitting, or in two or three sessions, and the same form of treatment may be employed for the lesser lacerations of the cervix. In the younger group of women, still in the childbearing age, the extensive lacerations of the cervix with scar tissue and

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ectropion should be required by trachelorrhaphy. After the menopause, or in women where future pregnancies are not considered the cervix should be amputated, as, is so doing, the organ in which 90 per cent of the carcinomas of the uterus develop is removed. Again, the endocervix and portio vaginalis should be thoroughly cauterized before the performance of a supravaginal hysterectomy to prevent the occurrence of stump carcinoma.

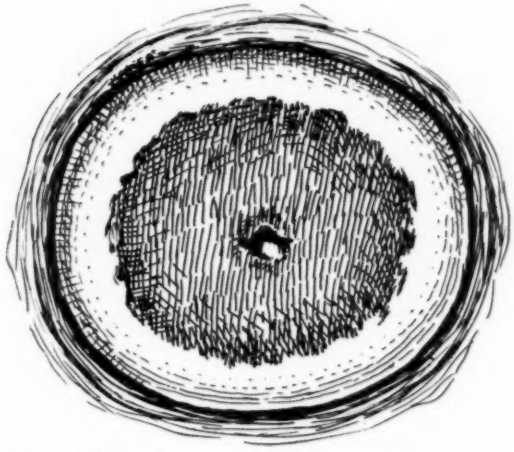

Fig. 1. Extensive erosion of the cervix following infection and inflammation.

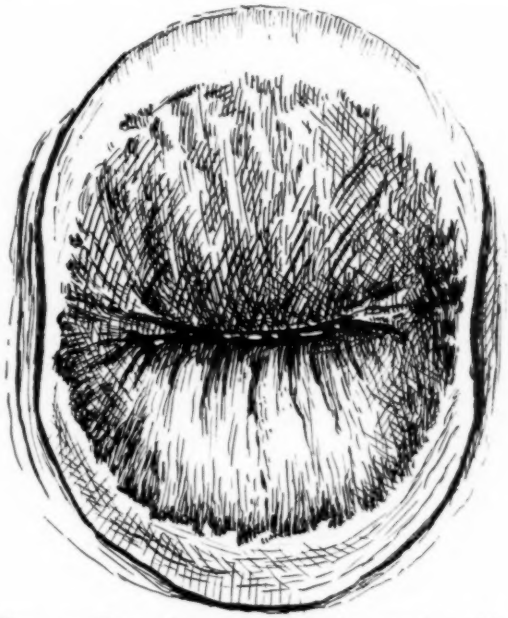

Fig. 2. Deep laceration of the cervix with ectropion. The scar tissue at the edges of the laceration keeps the cervical lips everted.

EARLY DIAGNOSIS

Biopsy. It is often impossible to differentiate, with the naked eye, between severe chronic inflammation and early carcinoma. If there is transition from chronic inflammation to carcinoma, in the interest of the patient, this should be ascertained as early as possible. A small lesion limited to the cervix is curable, while one which has extended beyond that organ in the rich lymphatics of the parametria is fatal in a very high percentage of women so afflicted. In order to establish an early diagnosis of carcinoma of the cervix there are three methods available: (1)colposcopy, (2) the Schiller test and (3) biopsy. The colposcope is a magnifying instrument which allows the detection of suspicious areas, patches of leukoplakia, for instance. The Schiller test is carried out by painting the cervix with an excess of Lugol solution; the normal cells take a mahogany brown color, while the carcinomatous, because of their loss of glycogen content, do not take the stain, so that carcinomatous areas appear as whitish spots in a dark mahogany background. Both the colposcope and the Schiller test point out the areas from which a biopsy should be taken. The histological examination of the excised tissue settles the diagnosis.

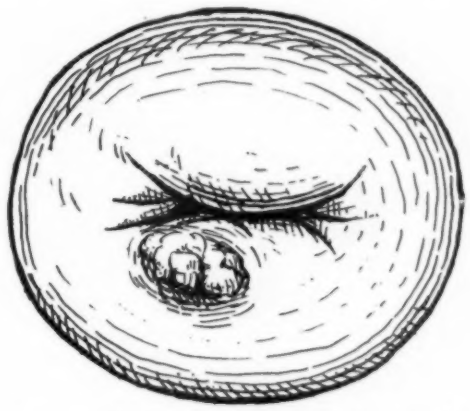

Fig. 3. Early carcinoma of the cervix involving only a small area on the posterior lip.

Three types of biopsy specimen may be obtained from the cervix; (1) from the portio or external surface; (2) from the

endocervix or cervical canal and (3) from a polyp which, under certain circumstances, may become malignant.

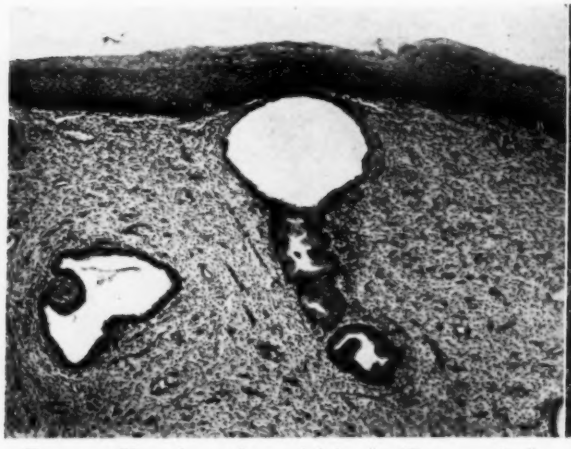

Fig. 4. Chronic endocervicitis, healing cervical erosion (second stage) and Nabothian cyst formation. No evidence of malignancy. × 50.

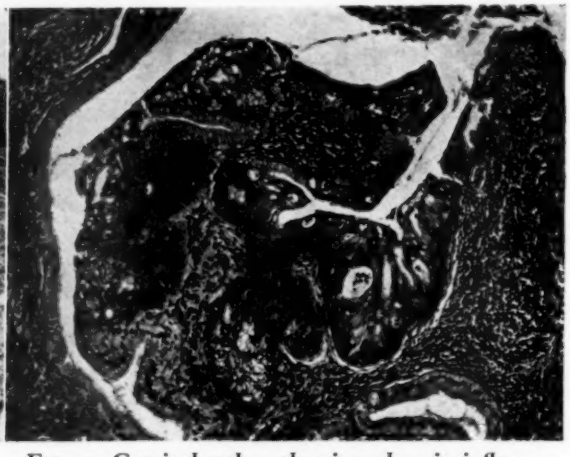

Fig. 5. Cervical polyp showing chronic inflammation, glandular hyperplasia, and epidermization. There is no evidence of malignancy. × 75.

TECHNIQUE

Biopsy of Portio. The cervix is exposed through a bivalve speculum and all secretions are removed from its surface as well as from the vaginal walls. The plug of mucus or mucopus in the cervical canal is dissolved by a weak solution of caroid applied on a cotton-wound applicator. The entire cervix is then painted with a germicidal solution; this may consist of 3½ per cent tincture of iodine, or of any other preparation which the operator may prefer. *It is a known fact that cutting in a carcinoma of the cervix with a cold knife may rapidly spread the disease to the lymphatics.* The electrically charged wire loop of the high frequency apparatus is the best cutting instrument devised for biopsies of the cervix. It cuts cleanly, does not char the tissues and seals the lymphatics as it cuts through. Anesthesia is usually not necessary for this procedure. In the absence of such an apparatus, a biopsy may be taken with a cold knife provided that an actual cautery is at hand to immediately cauterize the incised area. Light anesthesia may be necessary for this method, which is more traumatizing. In other words, the ideal method of performing a biopsy of the cervix is by means of the electrically charged wire loop, the next best being excision of the area with a knife, the No. 11 Bard Parker blade being the best for this purpose, followed by thorough cauterization of the area by the actual cautery. In this day and age, no biopsy of the cervix should be attempted unless facilities for cauterization are at hand.

Biopsy of Endocervix. After carrying out the cervical preparation already outlined, a cotton-wound applicator, saturated with a 2 per cent solution of nupercaine, is gently applied in the cervical canal and allowed to remain in situ for twenty minutes. If the cervical canal is not sufficiently patulous, it is gently (not forcibly) dilated with small graduated sounds, so as to allow the introduction of the smallest curette. The surfaces of the cervical canal are lightly gone over and endocervical mucosa obtained.

All the tissue removed at operation on the cervix, repair or amputation, should be considered biopsy material and so treated. A surface biopsy of a suspicious lesion may also be obtained by removing small bits of tissue for microscopic examination, by the sharp cutting clip forceps. Here again it is advantageous to cauterize the area from which the tissue is obtained. In any case, the material removed is placed in 10

per cent formalin solution and sent to the pathologist for examination. The first and last methods may be carried out in the office, while it is easier to hospitalize the patient for the second.

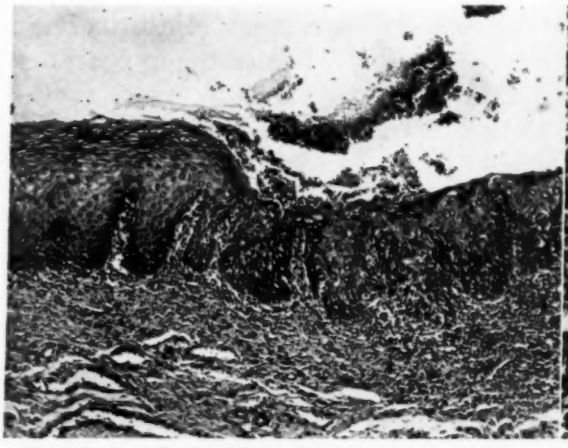

Fig. 6. Atypical epidermoid carcinoma, showing slight differentiation, confined to the surface of the cervix. × 75.

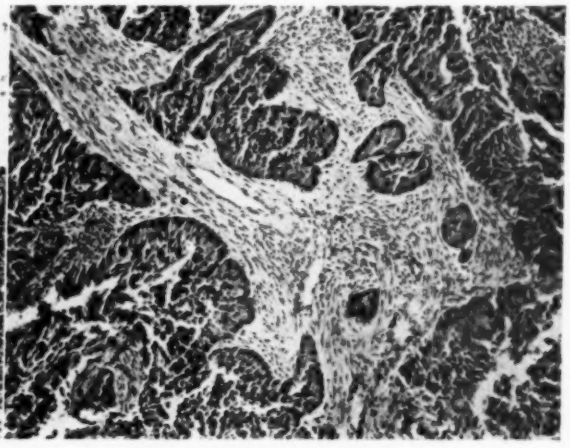

Fig. 7. Adenocarcinoma of the cervix, partly solid and partly glandular, growing with moderate rapidity and invading the lymphatics. × 75.

EARLY TREATMENT

By doing a biopsy on suspicious cervices, an early diagnosis of carcinoma of the cervix may be established. If the pathological report shows that carcinoma has already begun to develop, treatment by radium and deep *x*-ray therapy should cure a high percentage of these early cases. If, on the other hand, a report of chronic inflammation is received, the cervix should be cauterized or repaired, as the case may be, in order to prevent the future development of a malignant neoplasm.

Working along these lines at the New England Medical Center, we discovered last year 8 carcinomas of the cervix which could not be detected with the naked eye. These women were all treated by irradiation and their cervices are completely healed. The lesions were such early ones that the prognosis should be favorable.

I am indebted to Dr. H. Edward MacMahon, Professor of Pathology, Tufts College Medical School, for the photomicrographs illustrating this article.

SUMMARY

Carcinoma of the uterus occurs in the cervix in about 90 per cent of the cases. There are no symptoms in early carcinoma of the cervix. When the classical textbook symptoms appear, the disease is well established. In the state of our present knowledge, improvement in the results of cancer of this organ must come through prophylaxis, early diagnosis and early treatment. Prophylaxis rests on the periodic examination of all women, especially at the time of the menopause, and on the eradication of all irritative lesions of the cervix, such as erosions, polyps, lacerations and infections. It may often be impossible to distinguish between irritative lesions and beginning carcinoma with the naked eye. The early diagnosis must be established

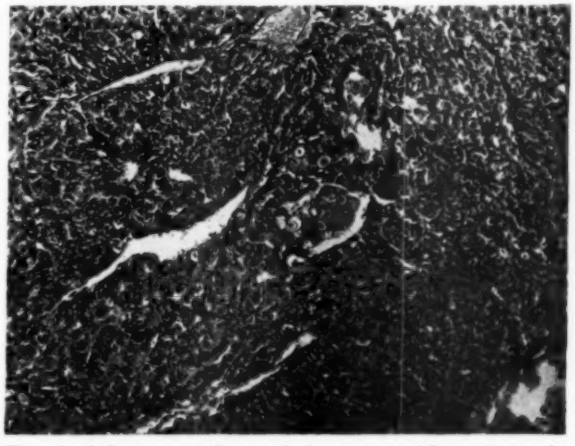

Fig. 8. Adeno-acanthoma (adenocancroid-carcinoma) of cervix. × 75.

by a biopsy and histological examination of all suspicious areas. The colposcope and the Schiller test point out the regions from which the biopsy should be taken on the portio. The electrically charged wire loop is the best instrument with which to obtain tissue for examination. Gentle dilatation of the cervix and light scraping of the endocervix with the smallest dull curette will give a specimen from that area In addition all particles of cervix removed at operation should be considered biopsy material and submitted to the pathologist. Diagnosis of carcinoma of the cervix by means of biopsy, before the appearance of the classical symptoms, followed by immediate treatment, irradiation or surgery, should lead to a high percentage of cures.

APPLICATION OF RADIUM IN CARCINOMA OF UTERINE CERVIX

A STANDARD COMBINATION FOR CONVENIENCE AND UNIFORMITY

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NEW YORK CITY

THE surgeon orders radium for carcinoma of the cervix through the hospital office, simply designating "Standard Combination." This includes:

(*a*) Two, 1 mm. wall thickness, platinum capsules each 25 m.c. W.D. (Working Dose, or actually emitted dose) for intrauterine use. These are supplied, placed in tandem in a thin rubber sac with cord attached. An introducing forceps accompanies this.

(*b*) Two, 2 mm. wall thickness, platinum capsules each 25 m.c. W.D. (Working Dose, or actually emitted dose) for vaginal use. A piece of ametallic rubber tubing, 3 mm. wall thickness and 8 inches long, together with a dumb-bell joint for fashioning a radium ring of required size to carry the vaginal capsules, are included.

The nurse in charge of the main operating room has a pattern showing how the radon ring is improvised.

In carcinoma of the cervix a dose of about 5500 m.c. hours may usually be given in a single continuous session of seventy-two hours; 100 m.c. W.D. for seventy-two hours equals 100×55, or 5500 m.c. hours.

After a "recovery interval" of eight to fourteen days, a second similar application is made if necessary. Subsequently, the patient receives deep *x*-ray therapy or telecurie therapy, as indicated.

In this arrangement, it is understood that the physicist calculates the number of millicuries which a capsule of given screenage (wall thickness) must contain in order to yield the working dose (emitted dose) which the surgeon requests.

In rigid platinum filtration there is a considerable loss of gamma-ray activity on account of absorption by the capsule wall. When the platinum capsule has a wall thickness of 0.5 mm., the loss by absorption amounts to about $\frac{1}{20}$ of the dose which the capsule contains; when the capsule wall is 1 mm. thick, the loss is $\frac{1}{10}$ and when it is 2 mm. thick, the loss amounts to about $\frac{1}{5}$.

RADIUM RULE

To calculate from the Working Dose what is the Total Dosage received:

Hours Application	Multiply by the Constant
10	10
24	22
48	40
72	55

RADON TABLE

Working Dose Applied (W.D.), M.c.	Number of Hours		W.D.		Constant		Total Dosage, M.c. Hrs.
100	10	=	100	×	10	=	1000
100	24	=	100	×	22	=	2200
100	48	=	100	×	40	=	4000
100	72	=	100	×	55	=	5500

In preparation, the patient's colon is flushed with warm water on the previous day and the bladder emptied by means of the catheter before operation.

The local growth is traumatized as little as possible; the gamma rays will remove the carcinomatous excrescence.

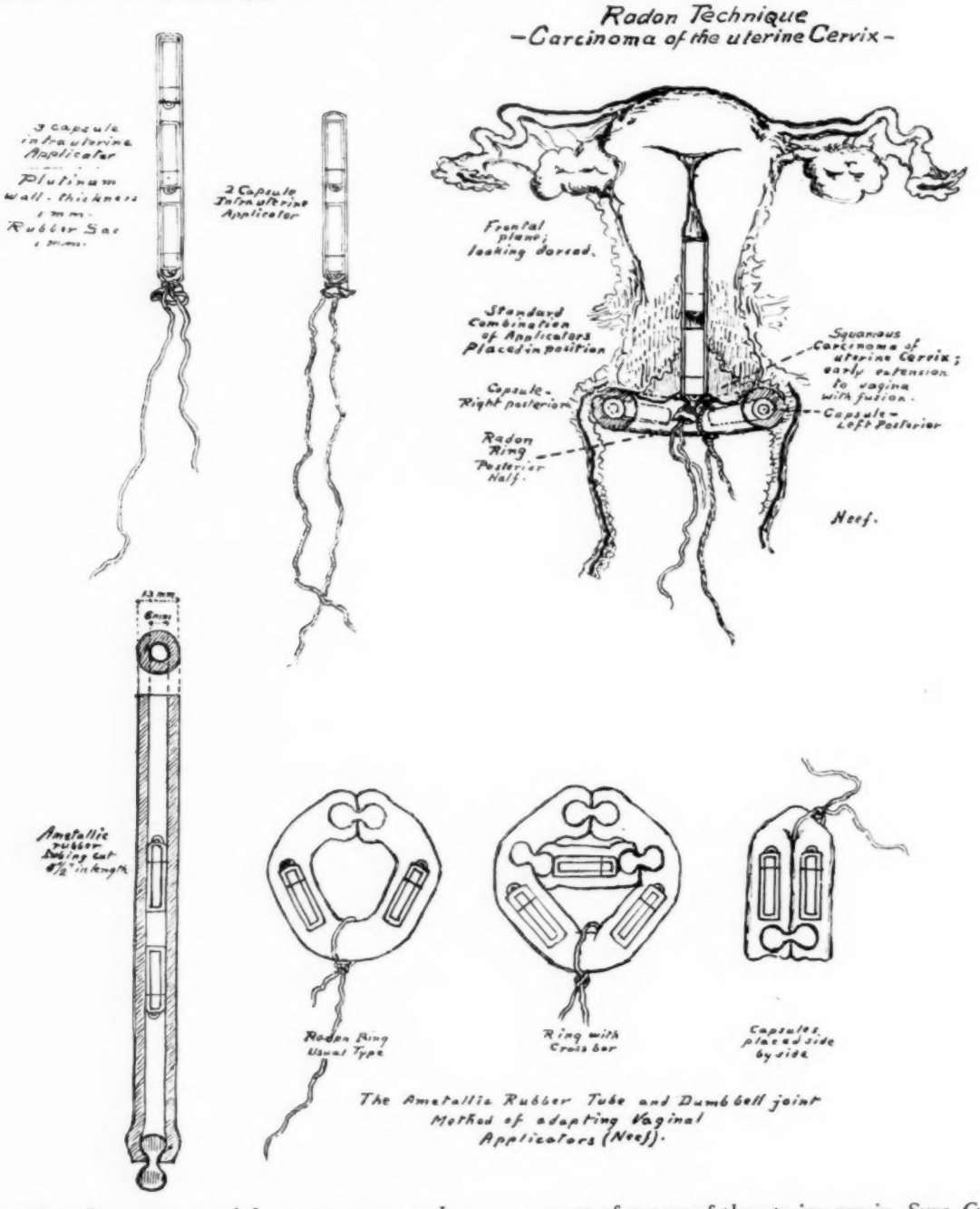
To keep the uterine and vaginal applicators from dislodging, the vagina is packed with 1½ inch wide gauze strip saturated with 2 per cent alcoholic mercurochrome solution.

During the irradiation period the patient's position is changed every four to six hours, the dorsal alternating with the right and left lateral postures.

Allonal grains 2.5 and codeine sulphate grain 0.5 are given at 8:00 P.M.

The diet is light and consists largely of fresh fruit.

After removal of the applicators, a warm saline douche or one with 1 per cent solupinol, or 0.1 per cent lysol is given and subsequently the bowel is flushed by means of a warm water enema.


Radon Technique
-Carcinoma of the uterine Cervix-
3 capsule intrauterine Applicator
Platinum wall - thickness 1 mm.
Rubber Sac 1 mm.
2 Capsule Intrauterine Applicator
Frontal plane; looking dorsad.
Standard Combination of Applicators Placed in position
Squamous Carcinoma of uterine Cervix; early extension to vagina with fusion.
Capsule - Right posterior
Capsule - Left Posterior
Radon Ring Posterior Half.
Neef.
13 mm.
6 mm.
Ametallic rubber tubing cut 6½" in length
Radon Ring Usual Type
Ring with Cross bar
Capsules placed side by side
The Ametallic Rubber Tube and Dumbbell joint Method of adapting Vaginal Applicators (Neef).

REFERENCES

NEEF, FREDERICK E. The treatment of advanced cancer of the cervix by vaginal and transperitoneal implantation of glass radium emanation capillaries. *Arch. Clin. Cancer Research*, 1: 1, 1925; Principles and technique involved in the present day treatment of cancer of the uterine cervix. *Surg. Gynec. Obst.*, 53: 241–249, 1931; A unified plan for keeping records of carcinoma of the uterine cervix. *Am. Jour. Surg.*, 13: 263–269 (Aug.) 1931; Biophysical factors concerned in the clinical course of carcinoma of the uterine cervix. *Am. Jour. Surg.*, 17: 259–269 (Aug.) 1932; The technic of radium-therapy in carcinoma of the uterine cervix. Publicado en el "Libro de Oro," homenaje al Prof. Dr. Angel H. Roffo con motivo de su jubileo de plata con la cancerologia. Las Ciencias, 1935.

PATHOLOGY AND OFFICE TREATMENT OF CHRONIC ENDOCERVICITIS

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IT has been about seventy-five years since Thomas Addis Emmett began his studies on "Erosions of the Cervix." During these many years much has been written by innumerable and diverse authors on all phases of cervical infections, including the far reaching systemic infection resulting from the underlying pelvic pathology. It may be readily conceded, therefore, that it would be extremely difficult, if not impossible at the moment, to bring forth a single new fact regarding chronic endocervicitis. Certainly if such a fact were established it would be front page medical news. On the other hand, medical progress demands, from time to time, the segregation of known facts on a given subject and these, coupled with the correlation of a sufficiently wide clinical experience, are of definite practical value. This is my only excuse for presenting another paper on chronic endocervicitis.

The most important desideratum in the study of chronic endocervicitis is a thorough understanding of the anatomy, physiology, pathology and bacteriology of the cervix and those structures in juxtaposition that are reached by its lymphatic drainage. Pathological anatomy, here as elsewhere in medicine and surgery, must be understood if we are to comprehend the modus operandi of disease processes.

In both structure and function the cervical mucosa differs widely from the endometrium of the corpus uteri. The former is composed largely of high columnar epithelium beneath which are deep penetrating racemose glands whose ostia open onto the surface of the endocervical mucous membrane; while the latter is composed of a stroma with penetrating tubular glands lined with cuboidal epithelium which is constantly passing through the active changes that are essential to menstruation and deciduation. The cervical mucosa therefore is very prone to bacterial infection, particularly the gonococcus; while the endometrium of the corpus uteri is usually immune. Consequently endocervicitis should be a very common pathological lesion, whereas endometritis should be seldom encountered. Pathologic study has proved beyond doubt the truth of this assumption.

The organisms most commonly producing endocervicitis are the gonococcus, staphylococcus, streptococcus and colon bacillus, the gonococcus and staphylococcus being by far the most prevalent. No habitat is more inviting to the gonococcus than the columnar epithelium of the endocervix and the underlying compound racemose glands.

Trauma, as lacerations during childbirth, instrumental dilatation, curettage, inadequate and improper cauterization, conization or surgical diathermy, the constant irritation of a stem pessary, opens up avenues for infection and are therefore predisposing factors in the production of chronic endocervicitis. Trauma, however, is only a contributory cause for it is ordinarily not the extent of the trauma but the incidence and virulency of the infection that produces the underlying pathology.

In children vulvovaginitis from any cause, the exanthemata, especially scarlet fever and diphtheria, and the general debilitating diseases often give rise to chronic endocervicitis. Thus the hematogenous

infections of the cervix cannot be denied. We have ample clinical evidence that, particularly following scarlet fever, acute pelvic infection in the form of salpingitis, ovaritis, and/or endocervicitis occur.

The mucosa of the cervical canal when chronically infected is edematous, swollen and often everted, while the mucosa of the portio about the external os presents a circumscribed area of glandular proliferation. The columnar epithelium covering the mucosa of the cervical canal, under constant stimulation of the infection present, actually "pushes" itself out on to the vaginal aspect of the cervical rim, replacing the stratified epithelium which is normally present in this situation, thus producing the so-called erosion. This erosion or "red area" about the external os, therefore, is not an ulceration, but a new formation of gland tissue and may, under certain conditions, become malignant. There is produced under the stimulation of continued infection, a hypersecretion from the glandular structures. Sooner or later the crypts of these glands become occluded with subsequent formation of cysts (Nabothian cysts). This cystic condition, which may or may not be visable on inspection, increases the bulk of the already hypertrophied cervix and thereby interferes with its circulation and muscular contraction. It is this pathology that is very largely responsible for the premenstrual and postmenstrual metrorrhagia, plus the copious mucopurulent leucorrhea, so constantly observed in chronic cystic endocervicitis. Beyond the confines of the cervix there is always some degree of posterior cellulitis, particularly about the uterosacral ligaments. Likewise, particularly when lacerations are present, there is apt to be some degree of lateral parametritis along the bases of the broad ligaments which may extend along the lymphatic channels for a variable distance.

Microscopically there may be the usual findings of a chronic inflammation. Often, however, there is very little inflammatory changes in the stroma, and, except for a preponderance of gland tissue, sections appear almost as normal cervical tissue. Section of a Nabothian cyst shows a large sac lined with columnar epithelium filled with clear mucus or mucopus. Surrounding this there is apt to be found a chronic inflammatory zone as evidenced by small round cell infiltration, edema, congestion or dilated lymph spaces, which of course produces more congestion and hypertrophy and this augments the pathological picture.

Infections of the cervix are characterized by a chronicity not characteristically found in other structures of the body, except those in the tonsils, the sinuses and the teeth. In fact, due to its similarity of behavior, the cervix has been aptly called "the tonsil of the vagina." The clinical course therefore is slow and insidious with little or no tendency to spontaneous cure.

The symptoms of chronic cervical inflammation are variable. Leucorrhea is always present; sometimes scanty, oftentimes profuse. In consistancy it may vary from clear mucus to mucopurulent to almost pure pus. There may be no other symptom. On the other hand, the symptoms may be many and severe—such as low backache, bearing down sensation in the pelvis, dull aching pain across the lower abdomen extending down into the pelvis, bladder urgency and frequency, with or without pain. General malaise, headache, achy pains in the muscles and joints which may be associated with "stiff" muscles are frequent complaints. Dysmenorrhea, menorrhagia, and, in severe cases with much erosion, metrorrhagia. Dysparunia is often present. Sterility is a frequent complaint and must be reckoned as one of the sequels of chronic endocervicitis, as evidenced by the frequency with which conception follows its relief or cure.

The prognosis in chronic endocervicitis is doubtful. When the infection is superficial and the concurrent inflammation mild and treatment is instituted early, complete recovery may ensue. On the other hand, when the infection is virulent and the coincident inflammation severe and treat-

ment inadequate, the prognosis progressively becomes more uncertain. Not only does the chronic inflammatory changes in the cervix progress but the associated lesions, as metritis, parametritis and posterior cellulitis, are continuously advancing. Furthermore, chronic cervical inflammation, which means long continued irritation, may be considered a prodrome of cervical cancer, for it is but a step from the extreme cell proliferation with an orderly arrangement that occurs in marked hyperplastic cystic endocervicitis to the disorderly arrangement of embryonal cells found in cancer.

Modern trends in medicine are towards prevention. Education of the doctor, as well as the layman, has brought this idea to the forefront. The old adage "an ounce of prevention is worth a pound of cure" has become the modern vogue.

Gonorrhea is responsible for a very large group of infected cervices. Prevention in this group has been a big job yielding very poor results. In the future, however, due to the recent renewed activity of all interested groups in the prevention and control of gonorrhea and syphilis, we may expect better results.

In the prevention of another very large group of cervical infections we must begin with the delivery of the child. Good obstetrics reduces to a minimum early and late sequels, thereby lessening disability. The cervix is spared much trauma if full dilatation is obtained before delivery is attempted. It may be "old fashioned" to keep the membranes intact until full cervical dilatation is accomplished but nevertheless the best obstetricians are still "out of step" with the idea of premature rupture of the membranes as a routine procedure. Only on indications do we rupture the membranes before complete or nearly complete dilatation of the cervix. Dry labor is always more exhausting to the mother and likewise more traumatizing to the cervix. Under any condition, when a full term child passes through the cervix, it is lacerated either microscopically or macroscopically, usually macroscopically. The extent of the laceration, in so far as the infection is concerned, is not of prime importance, for bacteria may enter through microscopic or macroscopic lacerations with equal facility. However, adequate postpartum attention, taking care of cervical lacerations until healing is completed, accomplishes much in minimizing or preventing the entrance of infection, and should be the routine after every delivery. Extensive cervical lacerations, where feasible, should be repaired immediately following delivery.

With all our admonition regarding the prevention of cervical infections, we still have chronic endocervicitis occurring in 60 per cent to 80 per cent of the women seen in private and hospital practice.

Effective treatment of chronic cervical infection is based upon the axim that "without a correct diagnosis there can be no intelligent treatment." Furthermore a clear understanding of the underlying pathology and the correct employment of the various methods at hand constitute indispensible adjuncts in the proper treatment of chronic endocervicitis. Choose a good method; perfect the technique and success is apt to follow its use. This we have found true in the cauterization method by the use of the small nasal type electric cautery.*

In order to more clearly outline the treatment by the cautery method, all cases of chronic endocervicitis may be placed in one of the following four groups:

Group 1. The recently lacerated cervix of four to twelve weeks duration of a superficial infection. The nulliparous cervix the seat of a mild gonorrheal or non-specific infection.

Group 2. The lacerated, eroded cervix of three to twelve months duration with somewhat more and deeper infection than in Group 1 with perhaps a few superficial cysts. This may obtain in a moderately infected nulliparous cervix.

* Other perfectly satisfactory methods for office treatment of chronic endocervicitis are Hyam's conization, accomplished by a high frequency current and coagulation diathermy.

Group 3. The lacerated, everted, eroded cervix of two to five or more years duration, moderately deeply infected and with or without visable cysts. This is found in the moderately deeply infected nulliparous cervix with or without erosion and cyst formation.

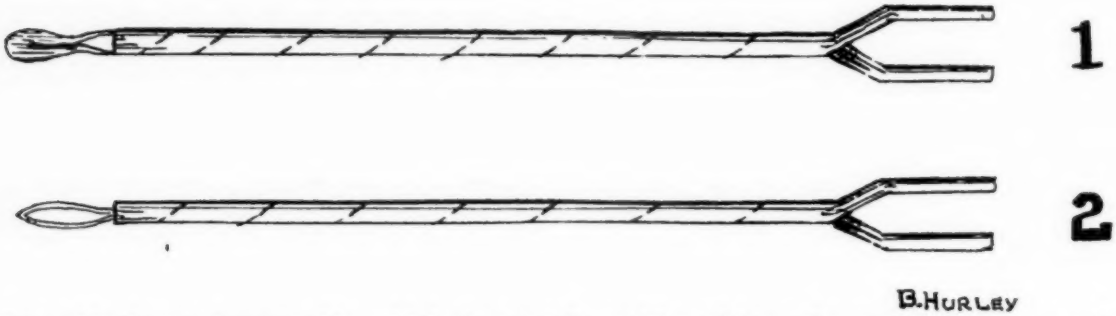

Fig. 1. Nasal type of cautery; No. 1, blade tip, generally used for striping or flat cauterization; No. 2, wire loop used for puncturing cysts. It may also be used for striping.

Group 4. The old lacerated, everted, eroded, hypertrophied, cystic cervix deeply and extensively infected and of long duration (from ten to forty or more years). The same condition is found in the extensively infected cystic hypertrophied nulliparous cervix.*

Such groupings, while more or less arbitrary, simplify treatment. For example, all of the cases in Groups 1 and 2 and the upper half of Group 3 may be successfully treated with the electric cautery. The cases falling in the lower half of Group 3 and all those in Group 4 cannot be successfully treated with the cautery; the Sturmdorf excision of the infected area only or amputation, using a modified Sturmdorf technique, gives excellent results.

The procedure for each group is as follows:

Group 1. Often in this early group we find a retroverted uterus, a few weeks postpartum, that should be corrected. When corrected and held in place with a pessary, involution of both uterus and cervix is stimulated and hence the cervical discharge is lessened. Local application of silver nitrate "stick" or a 20 per cent solution once a week, using an alkaline cleansing douche (sodium bicarbonate, borax, or sodium chloride, 4 drams to 2 quarts of hot water) once a day followed immediately by the knee chest position for five to ten minutes, will destroy superficial infections and promote kindly healing of the lacerated tissues. Tincture of iodine 3½ per cent or 4 per cent mercurochrome may be used with success. Far better, however, than any local application, even in the treatment of these very early cervical lesions, is the use of the electric cautery. With the small nasal type cautery using the blade or looped wire (Fig. 1, No. 1 and No. 2) linear striping (incisions) of the lacerated eroded surface is accomplished without pain (Fig. 2, No. 1). The stripings are placed about 1 cm. apart and extend 3 to 5 mm. deep, both lips being striped at the first sitting. In these early Group 1 cases merely cauterizing the erosion with the flat surface of the cautery blade often suffices. Mercurochrome 4 per cent should be painted over the cauterized cervix and a cleansing douche should be taken twenty-four hours later and repeated daily thereafter. Vaginal tampons in this type of office work are never used since we are not convinced of their accredited value. In three to eight weeks there is no sign of erosion. Inversion rather than eversion has taken place. Healing has been accomplished and the cervix is now a normal looking multiparous cervix free of infection and therefore of discharge (Fig. 2, No. 4).

Group 2. In this group the infection has gone deeper in to the cervical tissues, particularly the mucous membrane and

* The author's "grouping" in Christopher's Textbook of Surgery, Phila., W. B. Saunders Co., 1936.

glands, hence topical applications are *absolutely useless*. The technique of striping is the same as in Group 1, except that in this group the cauterization must be deeper and more extensive. Begin by cauterizing only one lip at a sitting. The striping must extend from high up in the canal, to or nearly to the internal os, out over and through the everted, eroded area to normal cervicovaginal mucous membrane, 1 to 1.5 cm. apart and 5 to 7 mm. deep (Fig. 3, No. 1). The remaining lip may be cauterized in two weeks. When healing has completely taken place in eight to sixteen weeks we have a fairly normal appearing multiparous cervix with very little if any discharge (Fig. 3, No. 3).

A note of warning should be sounded regarding striping (cauterization) in the canal of the cervix, for if too much of the mucous membrane with its epithelial covering is destroyed epithelialization cannot take place in a normal manner and hence some degree of stricture or stenosis will result. "Islands" of epithelium must be left in situ, otherwise re-epithelialization of the cervical canal cannot take place. The pencil type cautery therefore should never be used in this type of work.

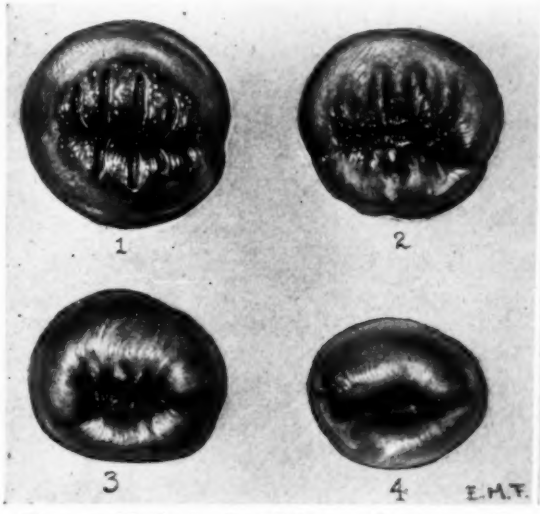

Fig. 2. Method of striping and process of healing. Cervix exposed and held in place by ordinary bivalve speculum. Small fine single tenaculum helps mobilize cervix, but is usually not necessary. Cautery tip (Fig. 1, No. 1.) heated to white heat (never blazing red) before making stripes or puncturing cysts. (Matthews. *Am. Jour. Surg.*, 6: 414–417, 1929.)

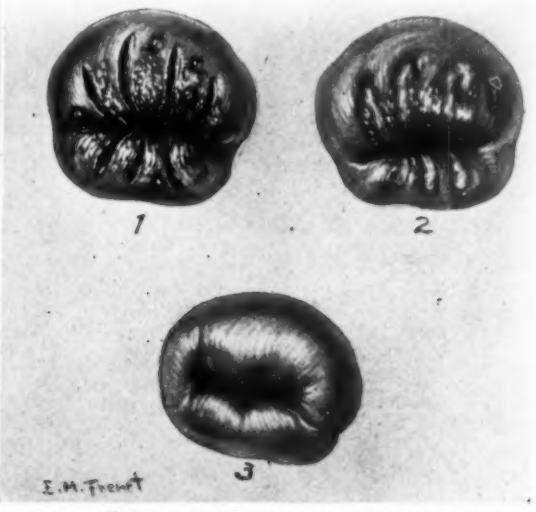

Fig. 3. Similar to Figure 2, except stripings are much deeper and cauterization generally more extensive due to longer standing and deeper seated infection. All visible cysts are punctured after method shown in Figure 4. (Matthews. *Am. Jour. Surg.*, 6: 414–417, 1929.)

Group 3. This is the borderline group. The cautery is not successful in all cases in this group particularly where extensive cyst formation and marked hypertrophy are present. Resort to operation by the Sturmdorf technique or amputation may be necessary. Experience counts for a great deal. Careful, thorough and deep cauterization is called for if success is to follow. For the beginner failure is quite probable. For one experienced in cauterization complete success is certain only for those cases falling in the upper half of this group; while for those in the lower half, with more extensive cyst formation and hypertrophy only partial success or even failure may result. Some form of anesthesia, usually local, may have to be used, particularly for the inexperienced hand that misdirects the hot cautery tip in an already apprehensive patient.

Furthermore there is likely to be some parametrial reaction following this type of cauterization and hence rest in bed for two or three days is in order. A warning

must be given in this connection, viz., never cauterize this group in the presence of acute or subacute inflammation. Marked

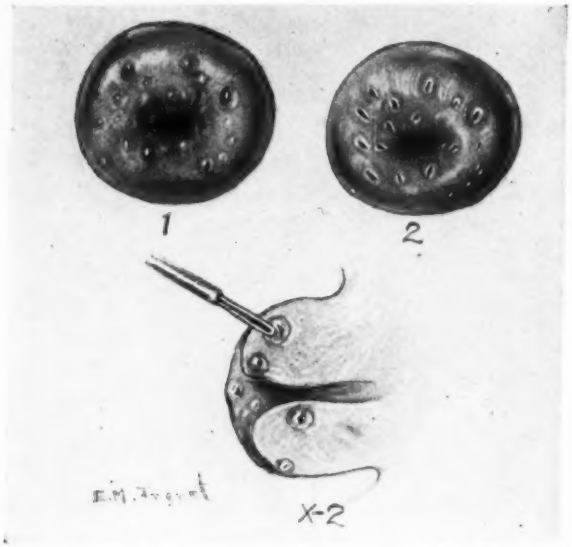

Fig. 4. Method of puncturing cysts. May be used alone or in conjunction with stripings as shown in Figures 2 and 3. This method is applicable to nulliparous cervix, particularly gonorrheal. Note small size of wire cautery tip. May also be used to destroy latent infection or abscess of Skeene's glands. (Matthews. *Am. Jour. Surg.*, 6: 414–417, 1929.)

local, as well as systemic, reaction is almost sure to follow. In fact in all cautery work acute and subacute inflammatory lesions in the pelvis are *very strict contraindications* to its use.

Group 4. This is the hopelessly infected cervix of long duration with many cysts and much hypertrophy, that nothing short of the removal of the infected area by the Sturmdorf cone operation or by amputation will relieve the symptoms. The cautery will not remove the infected area and therefore will not relieve the symptoms, especially the leucorrheal discharge.

The infected nulliparous cervix (gonorrheal or other infection) may be also treated successfully with cautery. In the earlier stages, after all acute symptoms have subsided, stripings similar to those for Groups 2 and 3 may be carried out. Any cysts may be punctured as illustrated in Figure 4. Early cases properly cauterized give excellent results. Late cases with many deep cysts are not so successfully handled with the cautery but are improved, depending upon the thoroughness with which the cautery is used. Since these cases often come for the relief of sterility as well as for leucorrhea, any form of treatment that will give at least some relief is commendable. Operation on such cervices, especially amputation is not desirable. In fact *amputation of the cervix during the childbearing age* is absolutely contraindicated, except under very special circumstances.

CONCLUSIONS

1. A clear conception of the underlying pathology of chronic endocervicitis is essential for its successful management.

2. Prophylaxis against trauma, laceration and/or infection of the cervix is most important. Likewise the prevention of gonorrheal infection.

3. Efforts directed toward the postpartum healing of all cervical lacerations are paramount.

4. Early recognition and treatment of chronic cervical inflammation gives the best results.

5. The proclivity towards the development of cancer in long continued chronic cystic endocervicitis must be kept constantly in mind; notwithstanding that a few eminent authorities question the truth of this statement.

6. The grouping herein proposed makes for more successful treatment, because the diagnosis of the extent of the infection is more nearly correct. The more extensive and deeper the infection the less successful will be the cautery treatment.

7. There is a large group of chronic endocervicitis cases in which no form of office treatment will effect a cure. The Sturmdorf operation or amputation of the infected cervix is therefore indicated in these cases (some in Group 3; all in Group 4). Amputation should not, unless imperative, be performed during the childbearing period.

8. The problem is difficult; opinions differ; however, with meticulous care in diagnosis and a skillful technique, success will ordinarily follow the use of the cautery.

CERVICAL POLYP*

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CERVICAL polypi are pedunculated growths varying in size from a pea to a walnut. They usually have their origin in the cervical canal and are covered by columnar epithelium. More rarely a solid or fibrous polypus develops from the portio vaginalis.

PATHOLOGY

The glandular type consists of a loose fibrous stroma, containing one or more blood vessels and covered by columnar epithelium similar to that lining the cervical canal. Small round cell and polymorphonuclear infiltration may usually be noted. Cervical glands may be present. Polypi arising from the vaginal portion of the cervix are covered by squamous epithelium.

ETIOLOGY

The exact cause is unknown. Polypi usually occur, however, as a late manifestation of endocervical inflammation.

SYMPTOMS

Spotting, staining, or frank bleeding between the menstrual periods should always make one suspect a cervical polyp. There may be a thick mucilaginous discharge tinged with blood. The showing of blood may follow coitus, douching or straining at stool.

DIAGNOSIS

This is usually easy. The polyp is felt by the examining finger and the speculum reveals a red pedunculated mass protruding from the external os. Rarely it may be necessary to dilate the cervical canal to expose the polyp.

TREATMENT

Small polypi with a thin pedicle may be removed in the office by seizing the tumor with forceps and twisting the pedicle until it breaks. The base may then be cauterized with the cautery tip. If this is not available carbolic or nitric acid may be used.

If the polyp is large and arises high in the cervical canal it is better to hospitalize. Under aseptic precautions the cervix is dilated and the polyp twisted off. The cervical canal is then thoroughly curetted with a sharp curette and cauterized. This removes other small polypi which may be developing and attacks the endocervicitis usually present. Rarely the polyp will be so large the pedicle cannot be reached. The tumor is seized with a volsella, the capsule incised and reflected and the mass twisted out of its bed or cut away with a scissors. The collapsed capsule is then twisted to torsion its vessels and the base cut through and cauterized.

Although usually benign, all polypi should be examined microscopically for evidence of malignancy.

* From the Department of Gynecology, Tufts College Medical School and the Gynecological and Obstetrica Service of the Carney Hospital.

CONGENITAL ABNORMALITIES OF RECTUM

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NEW YORK

THE surgical approach to congenital abnormalities of the rectum has never been clearly defined. Hence the practitioner suddenly meets an emergency with which he is ill prepared to cope. Although these abnormalities are by no means rare, but few are encountered by any one general practitioner. Not infrequently, they occur in districts where an expert opinion is difficult to obtain. Evidences of misguided efforts have often come to our attention, making subsequent attempt at repair extremely difficult. The urethra and the vagina are the organs most generally damaged, and the result is a fistula formation. For this reason we have suggested an approach to the problem which minimizes the risk of any serious complication.

No attempt will be made to explain the embryological factors leading to the various developmental arrests, since the causes are irrelevant. The accompanying diagrams illustrate the more common abnormalities, and should suggest the treatment. Obviously, some of the conditions are readily diagnosed but others necessitate surgical exploration. It is this latter group for which we have devised a technique.

Bearing in mind that the operation must frequently be performed under unfavorable circumstances, often by persons of limited surgical experience, and always upon poor surgical risks, the following procedure is suggested:

1. Inspect the perineum with care.
2. Digitally examine any orifices.
3. Attempt to palpate the perineal body and anal musculature.
4. If the examination gives *little* or no hope of immediate restitution of function, perform a colostomy at once. It is safest to make a median incision, as it permits easy access to all parts of the pelvis and abdomen, can readily be extended up or down, and is unlikely to result in hernia. The most distal part of the sigmoid which can be conveniently delivered should be chosen, its mesentery pierced by a glass rod, and the abdomen rapidly closed. Time is the essence of the operation, and should not be wasted by any exploratory procedures. Local anesthesia with .05 per cent novocaine is most satisfactory.

The colostomy should not be opened until the general condition of the patient demands it. Experienced operators may vary this procedure by inserting a catheter into the ileum, in the manner of an inverted inkwell and fixing the omentum over it. This provides a safety valve until such time as it is desirable to open the colostomy, when the catheter may be removed.

Technically, the operation is simple because there is always overdevelopment cephalad to the underdeveloped portion of the gut. The mortality is usually low.

5. If the examination gives some promise of immediate cure, a simple operation will offer a speedy solution of the problem.

An incision should be made from a point corresponding to the posterior margin of the anus and extending to the sacrococcygeal joint. Through this opening a finger should be inserted and the lowest position of the bowel determined. There is little immediate risk attached to the operation, and slight chance of any permanent damage to the patient, since no vital structures are encountered.

This procedure would demonstrate that the condition found in Figure 1A is susceptible of immediate cure. The fibrous plug between the anus and the rectum should be excised, the edges approximated, and a large tube introduced.

In this, as in all other surgery, the first great rule is, "Never take an unnecessary

risk." Therefore when in doubt perform a colostomy. Remember;

1. That fistulas can be enlarged and made to serve as an anus until the baby is older.

2. Vulval, vaginal and cloacal openings do not call for emergency operations.

3. Colostomy is indicated when the opening is into the bladder or posterior urethra, because of the danger of ascending infection of the urinary tract.

The following cases show the extremely good results to be expected of plastic operations performed when the patients have attained adolescence.

Case I. The patient had a condition similar to that depicted in Figure 1E for which an operation was performed under general anesthesia. The bowel was surrounded by an incision which was carried posteriorly to within an inch of the coccyx (Fig. 2). The bowel was dissected free from the vaginal wall in front, and from the surrounding tissue. The posterior incision was deepened to the levator ani muscle. The rectum was dissected free from the labia and vagina (Fig. 2B), the levator was now split and the bowel allowed to drop down through this aperture (Fig. 2C). The muscle was then closed above and below the rectum with interrupted sutures (Fig. 2D). The rectovaginal septum was brought down, and the mucous membrane of the vagina was sutured to the skin edges. The rectum was affixed to the levator ani with interrupted sutures, and the mucous membrane was brought to the skin edge in like manner. The skin above and below the anus was closed with interrupted sutures (Fig. 2E).

The patient made an uneventful recovery and leads a normal life.

Case II. A girl, aged sixteen years, born with an imperforate anus, had a colostomy performed when she was one day old. No attempt had been made to explore the site of the anus.

An incision was made posteriorly from the anus, the coccyx was removed, and exploration showed the anal canal and the end of the rectum attached to the posterior vaginal wall, with a well marked septum intervening, rather similar to Figure 2. An unsuccessful attempt was made to anastomose the distal end of the bowel to the anal canal. A second operation showed that the distal end of the large gut was strictured above its dense attachment to the vagina. Accordingly, it was decided to clear the hollow of the sacrum and pack it with gauze. Then the colostomy was completely separated from the abdominal wall and closed. The abdomen was then opened in the midline, the leaves of the pelvic mesocolon were divided, and the gut mobilized. The limbs of the pelvic loop were sutured together and attached to the gauze packing, which on removal from below brought the loop into the hollow of the sacrum and the colostomy site into the region of the anus. Appendicostomy was done through a stab wound, and the other abdominal wounds closed. The colostomy stoma was now opened, and sutured into the partially denuded anal canal.

Convalescence was smooth; the appendicostomy proved superfluous and, in the succeeding year, the girl gained twenty pounds in weight.

Case III. A young girl, aged fourteen years, had at birth a condition illustrated by Figure 2 with the exception that a small sinus existed between the lower end of the bowel and the anus. It is important to note that despite the small size of this sinus, she was able to defecate through it for fourteen years of normal living. When first seen by us she was suffering from constipation and subacute obstruction. At that time there was vomiting, tenesmus, and frequent passage of blood per rectum, and we were told that this condition had existed for weeks.

On examination, a rather well nourished but anemic and nervous child was seen, with a pot-bellied abdomen and a long, narrow chest, and an acute costal angle. The heart, lungs and kidneys were normal. The abdomen was distended and filled with gas. The large bowel, and the cecum especially, was enormously dilated. Operation was decided upon.

Stage 1. The exploratory procedure recommended in this article was performed. It was discovered that the hind-gut terminated at the peritoneal reflection. At about the second sacral vertebra a fibrous cord ran backward, upward, and forward to the anterior commissure. Below this constriction was a dilatation lined by mucous membrane and having no muscular wall.

Stage 2. A median incision was made. The sigmoid colon was delivered, and both leaves

of the mesentery opened. A gauze bandage was tied about the sigmoid and passed into the cul-de-sac. A sponge forceps was introduced through the anus and into the cul-de-sac, the gauze was grasped by them, and withdrawn through the anus. Continued traction on the gauze brought the loop of sigmoid through the anal orifice. The leaves of the mesentery were closed, the pelvic floor being reconstituted on a higher level and sloping from behind forwards and from above downwards. The abdomen was closed in layers.

Stage 3. The prolapsed loop of the sigmoid was then opened, and a rubber tube passed into

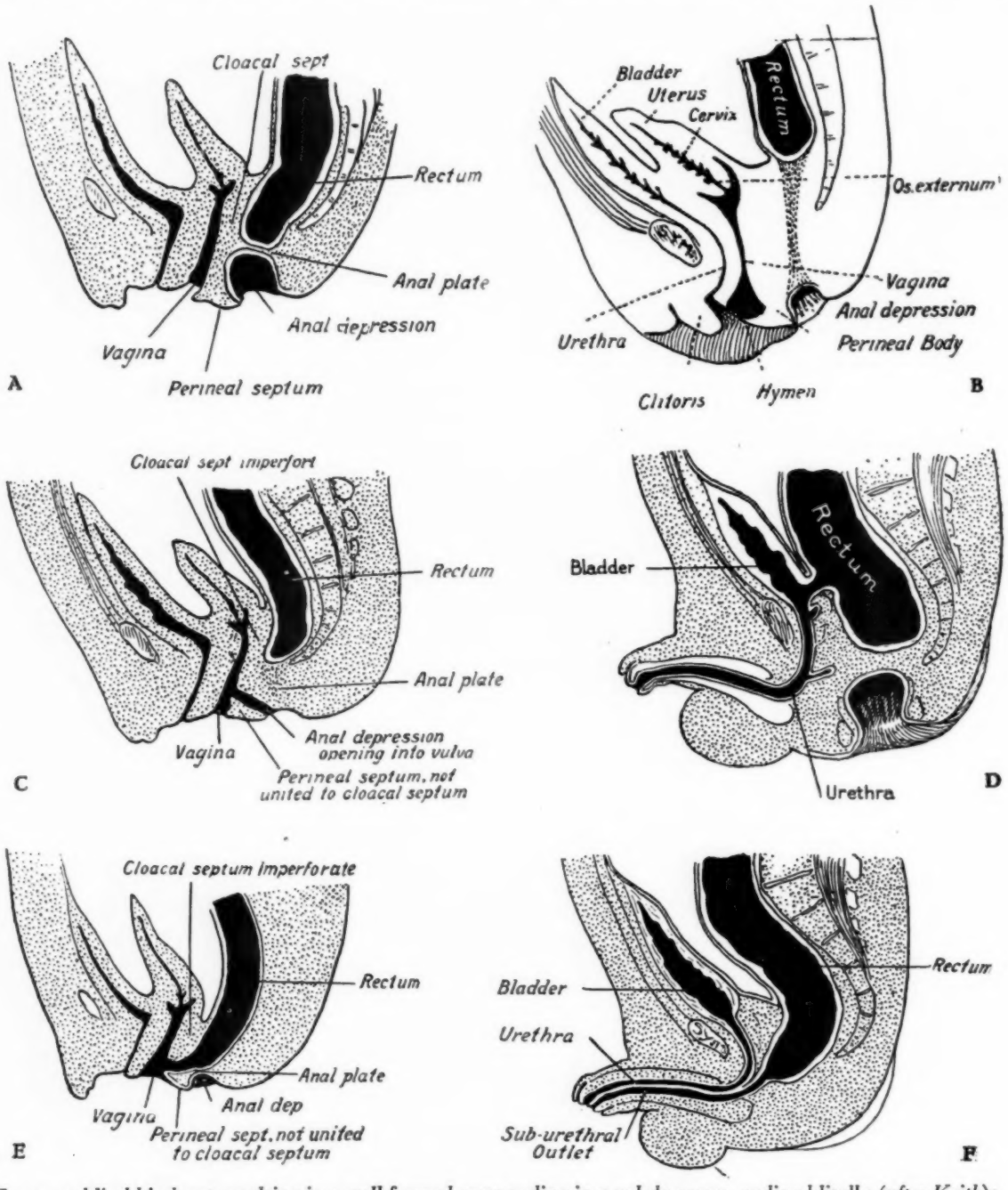

FIG. 1. A, blind hind-gut resulting in a well formed anus ending in a cul-de-sac; B, ending blindly (*after Keith*); C, anal depression opening into the vulva, perineum or scrotum; D, hind-gut opening into the bladder (*after Keith*); E, hind-gut opening into vagina (*after Keith*); F, imperforate anal canal with suburethral outlet (*after Keith*). (Lynch, J. M. Diseases of Rectum and Colon.)

each limb, the tubes and the bowel being held in position by interrupted sutures.

Sometime later, the "double-barrelled" perineal colostomy was converted into a single one by means of pressure forceps.

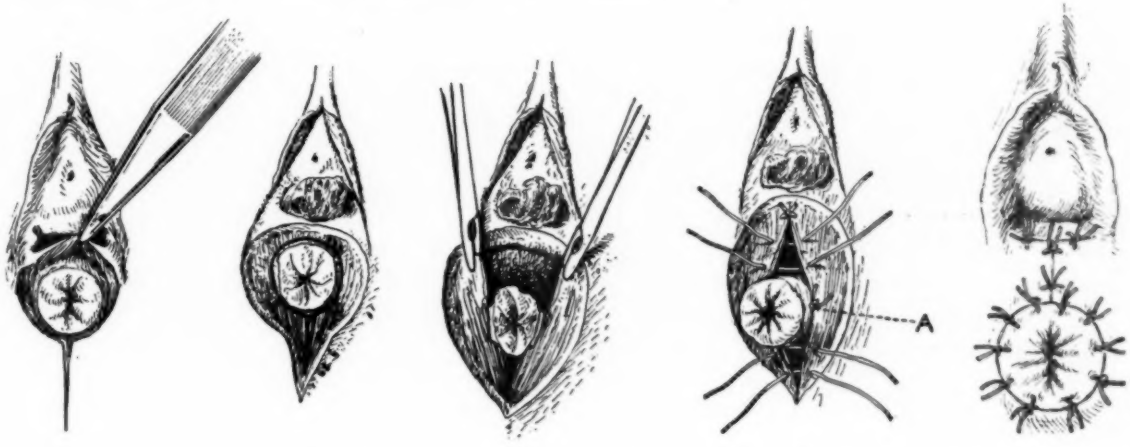

Fig. 2. Cloaca operation (*Lynch*); A, showing line of incision; B, second stage; C, third stage; D, fourth stage; E, fifth stage, operation completed. (Lynch, J. M. Diseases of Rectum and Colon.)

CONCLUSIONS

1. All malformations of the rectum present an emergency problem in diagnosis.

2. Some can be corrected at once; others necessitate a plastic operation at a later date.

3. Arrested development is compensated for by overdevelopment cephalad to it.

4. The exploratory procedure suggested in this article is without immediate danger, whereas a haphazard approach makes subsequent repair difficult.

FISSURE-IN-ANO

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FISSURE-IN-ANO is an exquisitely tender and agonizingly painful cleft in the anal canal usually located in the posterior and infrequently in the anterior commissure. It is caused by a diastasis of the conjoined longitudal muscle and attended with strong spasm of the sphincteric musculature.

Pain, slight loss of blood at stool and constipation are the chief complaints. The pain that may have been a tolerable irritation in the beginning becomes so severe within a week or two that the patient is unable to carry on his usual activities. During or shortly after bowel movement the pain appears and persists for a few minutes to a few hours. Sufferers have described the pain as a "red hot iron in the anal canal"; women regard the pain as more severe than the pains of labor. With each succeeding bowel movement the pain mounts in intensity so that bowel movements are deferred in apprehension of the associated excruciating pains. Pain is usually absent between bowel movements.

Occasionally, pain is referred to the urogenital organs with urinary obstruction, to the back and down the thighs.

An examination to ascertain the condition must be made without alarming the apprehensive sufferer. With the patient in the left Sims position, the nates are slowly spread apart and the patient encouraged to bear down as for stooling. This simple procedure is often sufficient to bring the fissure into view. If this maneuver is unsuccessful, the index finger makes light pressure around the anal margin until tenderness is elicited, the sphincter musculature is gently massaged through the skin, and a digital examination is done with the well lubricated finger making firm pressure away from the tender area. The spasmodic sphincter yields to the massage and the examining finger can explore the anal canal without hurt to the patient.

On approaching the suspected area, the anal lining should be palpated lightly. The roughened area of the fissure is readily recognized. After the digital examination, a well lubricated anoscope of small diameter can sometimes be inserted into the canal and the lesion visualized. If the patient is too fearful of examination, a local anesthetic (10 c.c. of 0.5 per cent novocain) is injected into the sphincteric musculature subjacent to the fissure. A thorough examination can then be made painlessly.

Table 1 shows the location of the fissure, based on a study of 124 consecutive cases of fissure-in-ano.

TABLE 1

	Male	Female
Posterior commissure	61	54
Anterior commissure	2	7

The lesion will be found in either commissure, usually the posterior. Early, a sharp linear break which looks like an incised wound, will be seen running from below the crypt margin to the anal verge. The margins and base of the rent are soft and pliable. A probe passed cautiously under the margins often extends freely for a centimeter into the surrounding tissue. With the edges drawn apart, circular bundles of muscle may sometimes be seen as they run at right angles to the tear. In an older lesion a knob of inflamed skin, the so-called sentinel pile, is often present at the inferior end of the fissure and is almost pathognomonic of the lesion. The margins are firmer, the base feels hard, pus is seen exuding from the wound, and the sphincter

spasm is intense. The slight damage found seems at first insufficient to account for the severe symptoms in the history and the spasm encountered in the examination. A close study of the anatomical factors involved is necessary to understand the events that produce fissure-in-ano with its severe pain and strong spasm.

The constancy of fissure at the commissures together with its great frequency at the posterior commissure is due to excessive strain of the anal lining caused by the attached portion of the conjoined longitudinal muscle.

The break in the anal lining occurs in the region between the lower end of the internal sphincter and the upper portion of the subcutaneous sphincter.

Spaces in which divisions of sphincteric musculature are confined, are formed by septa from the conjoined longitudinal muscle which insert into the deep surface of the skin, anal lining and submucosa (Fig. 1). When a break occurs, a space, with its contents of muscle, nerve and blood vessels, is exposed.

Levator musculature (pubococcygei and iliococcygei) through the medium of the conjoined longitudinal muscle, dilate and evert the anal canal during straining or defecation. This action of the levator can be demonstrated clinically during a digital examination. With a finger in the anal canal hooked around the levator musculature, the patient is asked to strain as he would for a bowel movement. The levators are felt to harden and the anal canal to dilate and evert.* As a result of this dilatation and eversion during defecation or straining, the anal cylinder ends at a higher level than it did during repose. This level corresponds to the area between the internal sphincter and the subcutaneous sphincter, and becomes the rim at the end of the anal cylinder where the breaking action takes place.

The anal lining is exposed to a strain from the distending action of the fecal mass and to the strain of the dilating action

* The author has called this, "Levy's sign."

Fig. 1. Schematized longitudinal section of anal canal (Author's modification of Robin and Cadiat). 1, levator musculature {pubococcygeus / iliococcygeus}; 2, longitudinal muscle of gut wall; 3, conjoined longitudinal muscle, name given by author to structure resulting from union of 1 and 2; 4, puborectalis muscle, division of levator muscle that acts as extrinsic muscle of gut wall; 5, profundus sphincter externus ani muscle, division of external sphincter that acts as extrinsic muscle of gut wall; 6, outermost layer of conjoined longitudinal muscle going to back of coccyx; 7, superficialis sphincter externus ani muscle lying in its space between septa of the conjoined longitudinal muscle; 8, subcutaneous sphincter externus ani muscle lying in a space between septa of the conjoined longitudinal muscle; 9, sphincter internus ani muscle divided by septa of the conjoined longitudinal muscle; 10, submucous longitudinal layer of muscle (sustentator mucosae of Rüdinger) with its terminal branches of the superior hemorrhoidal vessels, fusing at its lower end with a septum from the conjoined longitudinal muscle; 11, intramuscular gland; usually six are distributed in the crypt zone. They may penetrate the musculature as much as 2 cm.; 12, skin; 13, anal papilla covered by thin modified skin which extends upward to the end of the mucous membrane. It is in this modified skin above the hairline that fissure-in-ano occurs; 14, mucous membrane of the rectum which ends abruptly below; 15, fat in ischiorectal space. (*Author's conceptions of his findings based on his anatomical studies.*)

of the levator musculature by way of the conjoined longitudinal muscle. The pressure of the fecal mass within the anal canal

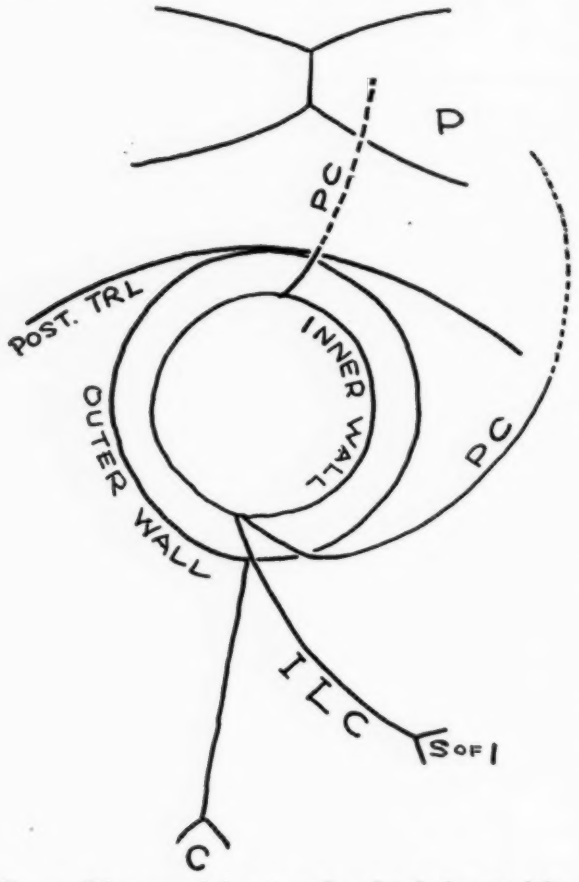

Fig. 2. Diagram of rim at anal outlet during straining with more levator musculature in the posterior commissure as compared to the anterior commissure. P, pubic bone. POST. TRL., posterior border of the triangular ligament. C, coccyx. INNER WALL, anal lining. OUTER WALL, muscle wall of anal canal. PC, pubococcygeus muscle, with short fibre going to anterior commissure and long fibre to posterior commissure. ILC, iliococcygeus muscle. S of I, spine of ischium.

is transmitted equally in all directions so that throughout its circumference, each part of the anal lining suffers an equal strain. The pull of the levator musculature, however, is proportioned unequally because of the uneven distribution of their fibers into the rectal wall. The decussation of the paired levators across the midline in the anterior and posterior commissures produces a strain during their contraction which is almost double that caused by the single levator muscle which is inserted in the side wall between the commissures. The posterior commissure fibres differ from those in the anterior commissure in two ways; (1) the longest fibres of the pubococcygei are inserted into the posterior commissure whereas the shortest are inserted into the anterior commissure; and (2) the iliococcygeus on either side sends fibres to the posterior rectal wall where they decussate in the posterior commissure, none going to the anterior commissure. The anal lining is thinnest in the region between the internal and the subcutaneous sphincters.

The factors engaged in the causation of fissure-in-ano are: (1) thin anal lining; (2) both levators in each commissures; (3) in the posterior commissure decussation of the fibres of the iliococcygei and the longest fibres of the pubococcygei; therefore, greatest volume of levator fibres are present in the posterior commissure (Fig. 2).

Contraction of the levators produces the greatest strain in the anal lining of the posterior commissure where the decussating fibres pull away from each other. When the diastasic strain on the anal lining becomes excessive, a break occurs and a fissure-in-ano results. The space corresponding to the involved membrane is exposed; small, torn vessels account for the slight bleeding; and torn nerve endings produce the pain and reflex spasm of the sphincteric musculature—developing a vicious cycle. Should infection occur it is confined within this space by the spasm of the sphincteric musculature which prevents drainage; inflammation of the nerve endings increases the sensory irritation with consequent spasm of the sphincters, which, in turn, further compresses the involved nerve ends, causing increased pain and intensifies the reflex spasm. These nerves derive their origin principally from the third and fourth sacral roots which, in turn, are intimately associated with the roots of the lumbar and dorsolumbar plexuses. From the sacral roots, fibres supply the musculature of the urogenital

perineum and skin, and in this way produce referred pain and spasm anterior to the rectum. Pain in the back and thighs is due to the spread of the sensory disturbance to the lumbar and lumbodorsal roots.

The infection may follow the channels of the inferior hemorrhoidal artery nerve and vein as they run in and through the septa of the conjoined longitudinal muscle and present as an abscess in the neighboring tissues or, if the infection remains localized, results in the fibrosis of the affected part, forming a hard unyielding area in an otherwise resilient elastic canal.

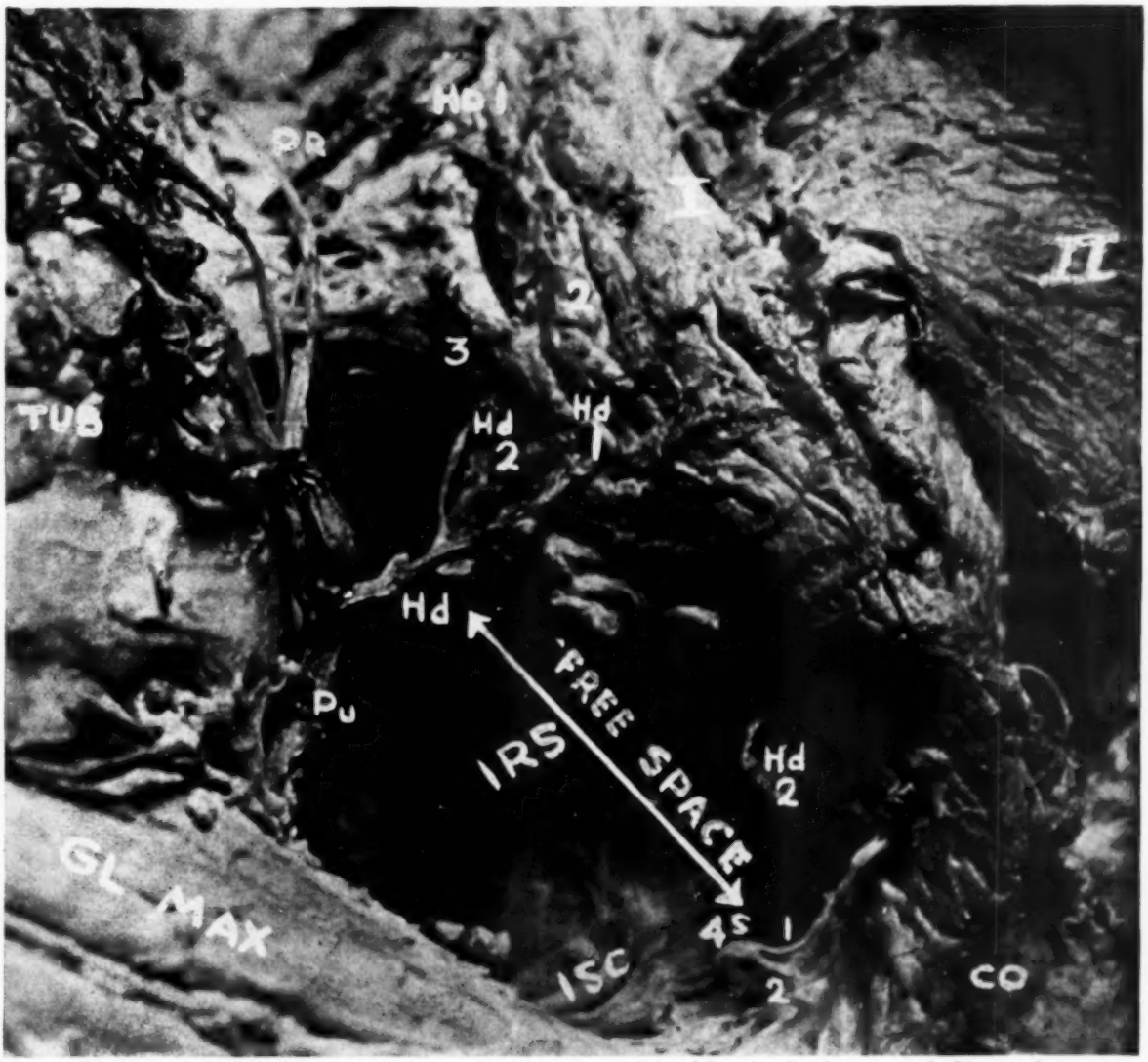

Fig. 3. Photograph showing nerve supply to the anus. II, conjoined longitudinal m.; IRS, ischiorectal space; 1, subcutaneous sphincter externi ani m.; 2, superficial sphincter externi ani m.; 3, profundus sphincter externi ani m.; PU, pudic artery, vein and nerve; Hd, inferior hemorrhoidal artery, vein and nerve; Hd1, superficial branch; Hd2, deep branch; PR, perineal artery, vein and nerve; TUB, tuberosity of ischium; GL. MAX, gluteus maximus m.; CO, coccyx; 4S, fourth sacral nerve; ISC, ischiococcygeus m.; $4S_1$, superficial branch of fourth sacral nerve; $4S_2$, deep branch of the fourth sacral nerve. The perineal division of the fourth sacral nerve, 4S, is the principle nerve involved in pain and spasm caused by fissure in the posterior commissure. (Levy, Anorectal Musculature. *Am. Jour. Surg.*, 34: 141–198 (Oct.) 1936.)

Note: The I in the illustration should be 1.

Management of fissure-in-ano is directed toward the control of spasm and infection. In those patients where the margins and base of the fissure are infiltrated, with pus in the space, the treatment is surgical. Such

a procedure should be done in an operating room; its discussion is outside the scope of this paper which is confined to office treatment. The early fissure with soft, pliable base and edges, is a variety of fissure-in-ano which can be treated as an ambulatory case. The treatment is directed against infection and spasm.

To overcome the pain and spasm an oil soluble local anesthetic such as anucaine is employed with gratifying results when the following considerations are observed; (1) ampoule should be warmed before using; (2) a sterilized bone dry 10 c.c. lock syringe with a No. 20 gauge 2 inch needle attached for injection; (3) knowledge of the nerve supply to the part; (4) solution must be deposited in the deep tissues; not a drop should infiltrate the skin.

The skin is prepared by painting with 3½ per cent tincture of iodine. At a point midway between the coccyx and the commissure, the needle is thrust through the skin and when the resistance of the musculature beneath is felt, the injection is begun, distributing 10 c.c. in the midline and for an inch on either side, and a few drops are deposited in the bed of the fissure (Fig. 3).

Within a minute, there is relaxation of the sphincter and the pain disappears. Ichthyol 10 to 20 per cent on a swab is applied to the fissure. The sphincter should be vigorously massaged to prevent the pooling of the injected oil.

The patient should report daily for ichthyol application and digital examination. He is advised to refrain from raw fruits, vegetables and condiments, and encouraged to move his bowels, following defecation with a hot sitz bath. Mineral oil should be taken freely throughout the course of treatment. At the end of the week if the condition appears to be under control but some spasm is still present, injection of anucaine may be repeated. Treatment usually extends over a period of one month.

Should the pains persist despite this medical attention, then fissure-in-ano must be treated surgically.

Anterior fissures are treated similarly.

SUMMARY

1. The pathologic physiology of fissure-in-ano is described.

2. The basis for selection of the type of fissure for ambulatory medical treatment is presented and the treatment outlined.

REFERENCES

Robin et Cadiat. Journal de Panat, et da la physiol, 1874, pp. 589–605.

Tuttle. Diseases of the Anus, Rectum and Pelvic Colon. Ed. 2, Appleton, 1907. pp. 291–318.

Lynch, J. M. Diseases of the Rectum and Colon. Phila. Lea and Febiger, 1914, pp. 122–130.

R. B. Gorsch, M.D. Oil soluble anesthetics in proctology, *Med. Rec.*, pp. 35–38 (Jan. 3) 1934.

Yeomans, F. C., Gorsch, R. V., and Mathesheimer, J. L. *Tr. Am. Proctol. Soc.*, 1927, pp. 24–32.

Yeomans, F. C. Proctology. New York, Appleton & Co., 1929, pp. 196–207.

Hiller, R. I. The anal sphincter and the pathogenesis of anal fissure and fistulas. *Surg., Gynec. and Obst.*, 52: 921–941, 1931.

Gabriel, W. B. Principle of Practice of Rectal Surgery. London, H. K. Lewis & Co., Ltd., 1932.

Milligan, E. T. C. and Morgan, C. Naunton. Surgical anatomy of the anal canal with special reference to anorectal fistulas. *Lancet*, 2: 1159–1156, 1213–1217, 1934.

Levy, Edward. Anorectal musculature. *Am. Jour. Surg.*, 34: 141–198 (Oct.) 1936.

Daniels, E. A. Anal fissure, anal spasm, and anal stenosis. *Am. Jour. Digest. Dis. and Nutrition*, 3: 775–783 (Dec.) 1936.

CRYPTITIS

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CRYPTITIS is an inflammation of the crypts of Morgagni, variously termed as anal pockets or semilunar valves. It will be remembered that the rectal mucous membrane ends distally in an irregular border, composed of small folds stretched across from the base of one column of Morgagni to another, their concavity being directed upward. They vary in number from five to twelve, and measure in width from 6 to 12 mm. These crypts, whose function is not thoroughly understood, may become clogged with fecal matter, which, because of the shape of the crypt, is not easily expelled. The decomposition of the fecal matter or retained secretion, and the consequent irritation of the crypt starts an inflammation known as cryptitis which, at times, progresses to suppuration. Foreign bodies also may become lodged in crypts. Thus, I have occasionally removed a chicken bone, or a fish bone, seeds and similar objects from diseased crypts, with almost immediate relief of symptoms. Furthermore, frequent, loose and watery stools also give rise to irritation of the anal passage.

SYMPTOMS

As in most other inflammatory processes, the condition may assume either an acute or chronic form. When the cryptitis is acute, the symptoms are extremely severe, and the tissues involved become very sensitive. Pain is of a sharp and throbbing nature, especially when pus is forming. It is markedly increased on defecation. The anus becomes so tight that instrumentation is almost impossible.

In the chronic form, which is encountered more frequently, the pain is more of a dull and aching character. It is likewise increased during defecation, and is usually worse after exercise and on standing a long time. Next in importance to pain are the attacks of itching near the anus, not relieved by scratching. This results from the hypersecretion of mucus which occurs in the inflamed crypt as well as actual pus, which overflows from it and, as it runs down the mucous membrane of the anal canal, produces an irritation and consequent pruritus.

Furthermore, in aggravated cases accompanied not only by a spasmodic sphincter but also by a contraction of the levator ani muscles, sacrococcygeal neuralgia, constipation, prostatic irritation, frequent micturition and pain in the back and down the legs, are troublesome manifestations.

DIAGNOSIS

In the acute form, it is perhaps best not to do much examining, either digitally or with instruments. Let the patient take frequent hot sitz baths and apply nupercaine or other sedative ointment, locally for a day or two, until the spasm of the external sphincter relaxes somewhat. Then, to further minimize the discomfort incident to examination, cotton pledgets saturated with a 10 per cent cocaine solution are applied for a few minutes, or better still, the external sphincter is infiltrated posteriorly and somewhat laterally with 0.5 per cent novocaine solution. The perianal skin is now palpated for any areas of induration or tracking, which may lead to the inflamed crypt on the inside of the anal canal. The finger is now gently introduced into the canal and its circumference examined. This will reveal the affected area, in the form of a tender swelling at one side or other of the anal canal.

As a further confirmatory evidence an anal speculum of the removable slide variety is inserted, and the crypt is inves-

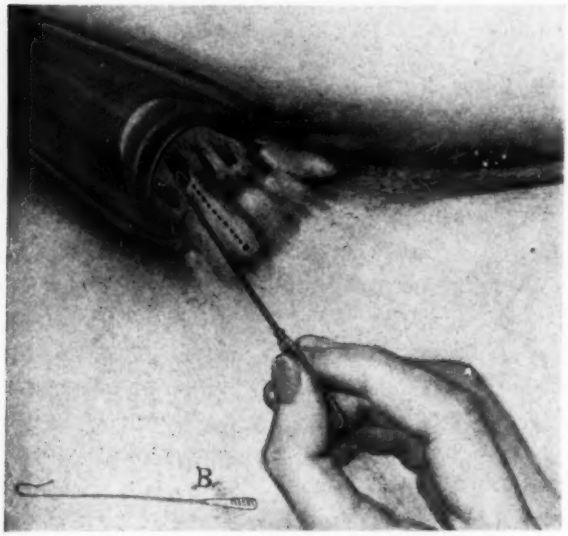

Fig. 1. Exposure of the anal canal through Humphrey's speculum; shepherd's crook probe introduced into cryptic pocket leading down into hypertrophied radial fold. B, shepherd's crook flexible probe. (*After Tuttle in* Lynch, Diseases of Rectum and Colon.)

tigated by means of a silver probe. This will show whether sinus or fistula formation has complicated the original inflammation. In using the probe, it cannot be overemphasized that one should use the gentlest care, because this manipulation is most painful, and some surgeons even postpone its use until the patient is on the operating table.

ASSOCIATED CONDITIONS

Papillitis is associated with cryptitis in about 50 per cent of the cases. This is an inflammation of the papillas, which occur as an irregular line of small, pointed or triangular projections, encircling the juncture of the anus with the rectum, called linea dentata. They are located at the lower extremity of Morgagni's columns, upon the edges of the crypts.

At times, the chronic inflammatory reaction and decreased elasticity of the tissues, result in a tendency to anal fissures. Proctitis with internal hemorrhoids, or a blind internal fistula, are likewise frequently associated with cryptitis.

TREATMENT

Mild cases of cryptitis are sometimes cured by regulating the bowels, by local cleansing, and by making topical applications to the inflamed crypt. Pockets are exposed through a suitable speculum and irrigated with some mild antiseptic solution, after which they are swabbed with ichthyol on a bent probe. This is continued until all the pain has disappeared.

In the more severe cases, however, surgical treatment, which can be carried out in the office, is indicated, since cure is much more rapid and certain, than when palliative measures are employed. The technique is as follows:

The sphincter is anesthetized by local infiltration with 0.5 per cent of novocaine solution and the inflamed crypt is exposed by a Humphrey's duckbill type or a Brinkerhoff, removable slide type, speculum. A bent probe is passed into the crypt and the valve is put at a tension. Then, with scissors curved on the flat the valve is excised, bringing out the incision a little on the skin for the purpose of drainage. After all bleeding is checked a small piece of iodoform gauze is placed on the raw surface.

The postoperative care consists of hot sitz baths of permanganate of potassium solution, 1 to 10,000, twice daily; mineral oil, ½ ounce morning and evening; the omission of raw vegetables and raw fruit from the diet for about one week; and subsequently, thrice weekly visits to the office, during which topical antiseptic or stimulating applications are made to the raw surface, until it is entirely healed.

In those cases, associated with other definite rectal pathology such as an extensive fistula or a chronic anal fissure with troublesome internal hemorrhoids, the patient is better hospitalized, and the inflamed crypt as well as other pathology properly dealt with surgically.

CASE REPORTS

Case 1. H. K., male, aged forty-three years, presented himself in 1935 for the relief

of rectal pain and pruritus ani, from which he was suffering intermittently for the past six months. The pain was at first of a throbbing nature, later assuming the form of a dull ache. Examination revealed a slightly swollen and inflamed skin tag on the right side at about four o'clock, from which a drop of pus exuded on slight pressure; and by palpating this swelling one could detect a small tract beginning at about one inch posteriorly and extending toward an anal crypt, from which it had apparently originated. The perianal skin was otherwise of normal appearance.

This man was operated on at the office. After the external sphincter and the small fistulous tract were locally infiltrated with 0.5 per cent novocain solution, a small bivalve speculum was inserted into the anal canal. A hooked probe was now introduced into the inflamed crypt and, as it was held somewhat at a stretch, the whole valve was cut away exposing a raw surface. The rest of the fistulous tract was finally dissected out, and a strip of iodoform gauze placed in the anal canal and external wound.

The postoperative care was carried out as described, and the wound was completely healed in three weeks. The pain and itching likewise completely disappeared.

Case II. Illustrates the necessity for hospitalization. Mrs. M. L., aged thirty-five years, was referred because of complaints of occasional rectal bleeding, pain and protrusion on defecation. Bleeding of bright red blood has occurred periodically for the past four years. The pain began two years ago after the passage of a very hard stool and, always worse in defecation, has progressively increased in severity. The protrusion appeared about one year ago, is reducible, but reappears immediately after straining.

On inspection, a chronic and indurated posterior anal fissure together with a protruding mass, consisting of prolapsed mucosa and anal papilla, was visible. After a local infiltration of 0.5 per cent novocain it was possible to complete the examination digitally and anoscopically. Very large internal hemorrhoids and elongated anal papillae were then seen at about nine o'clock. At the side of one of the papillae a slightly inflamed area was apparent; this was tested with a hooked probe, and found to be a diseased crypt. In this case hospitalization was advised for the eradication of the whole pathology including the diseased crypt, as revealed by the examination.

SUMMARY

1. Cryptitis is an inflammation of the crypts of Morgagni, or anal semilunar valves. It may be acute or chronic.

2. In the acute form, the most important symptom is a constant sharp pain, increased on defecation, and becomes throbbing in character as pus forms. In the chronic forms, this sharp pain changes to a dull ache; attacks of itching also supervene.

3. The diagnosis is made by the history, digital and instrumental examination.

4. Papillitis, fissure-in-ano, internal hemorrhoids, blind internal fistula and proctitis, may be associated with cryptitis.

5. Mild and uncomplicated cases of cryptitis may be satisfactorily treated in the office; when associated with other more important anorectal pathology, it is wiser to perform the whole operation in the hospital.

REFERENCES

1. Pennington, J. Rawson. A Treatise on the Diseases and Injuries of the Rectum, Anus and Pelvic Colon. Philadelphia, P. Blakiston's Son and Co., 1923, p. 460.
2. Lynch, Jerome M. Diseases of the Rectum and Colon. Philadelphia, Lea and Febiger, 1914, p. 216.
3. Yeomans, F. C. Proctology, New York, D. Appleton & Co., 1929, p. 257.
4. Hirschman, J. L. Handbook of Diseases of the Rectum. Phila., C. V. Mosby Co., 1926, p. 305.
5. Byland, Nels O. Cryptitis. *Tr. Am. Proctol. Soc.*, p. 20, 1931.

HEMORRHOIDS

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THERE are two distinct anatomical and clinical types of hemorrhoids; internal and external hemorrhoids arising from the internal and external hemorrhoidal plexus respectively.

The internal hemorrhoidal plexus of veins lies under the mucous membrane of the lowest inch of the rectum, and the upper part of the anal canal, above the anal valves. From this plexus, the radicals of the superior and middle hemorrhoidal veins pass upwards and soon perforate the muscle coats of the rectum. Internal hemorrhoids are produced by dilatation of this plexus; low grade inflammation with an increase of fibrous tissue, and an increased blood supply.

The external hemorrhoidal plexus encircles the anal verge and lies under the skin. It communicates with the internal plexus above, by means of straight vessels which run upwards in the columns of Morgagni. These vessels pass through the longitudinal muscle of the anal canal near its insertion.

CAUSATION

The internal hemorrhoidal plexus is in direct communication with the portal system and since this venous system is devoid of valves, venous back pressure occurs in the lower rectum and anal canal. The erect position of man increases this pressure. Straining at stool, as the result of constipation or diarrhea, leaves the internal hemorrhoidal plexus unsupported by the relaxed sphincter muscles, whilst contraction of the rectal wall above forces more blood into it. The habitual use of aperients, more especially calomel, salts and aloes should be avoided for this reason, and because they undoubtedly produce irritation of the mucous membrane of the rectum and colon. Prolonged standing, horse riding and straining at work, are factors in the production of piles. Any of the many causes of portal obstruction increase the dilatation of the internal plexus. However, many cases of internal hemorrhoids occur without any definite cause, and further, there is no doubt that there is sometimes an hereditary factor.

As the hemorrhoid increases in size, at first it tends to prolapse through the anus on defecation, returning spontaneously. Later, the prolapse has to be reduced, and finally the internal hemorrhoid remains permanently outside, due to eversion of the lining of the anal canal and stretching of the longitudinal muscle of the rectum and also of the anal sphincters. In advanced cases, the dilatation of the internal plexus is directly continuous with a similar dilatation of the external plexus. This results in a composite hemorrhoid called an intero-external pile. It consists partly of internal hemorrhoid covered by mucosa and partly external hemorrhoid covered by skin. Squamous epithelium may often be seen growing upwards over the red mucous membrane.

SYMPTOMS

Pain is not a usual symptom of internal hemorrhoids. In early uncomplicated cases, piles lie entirely within the rectum and are composed of comparatively insensitive tissues. Vague discomfort, dull aching or backache may be present.

Bleeding on defecation is by far the commonest complaint. This is slight at first but occasionally may be very severe. A severe degree of secondary anemia may result from the constant steady loss of blood

and a large quantity of blood may accumulate in the rectum with little sign of external bleeding.

Fig. 1. Anorectal ring appearing in the proctoscope. The x marks the site of injection.

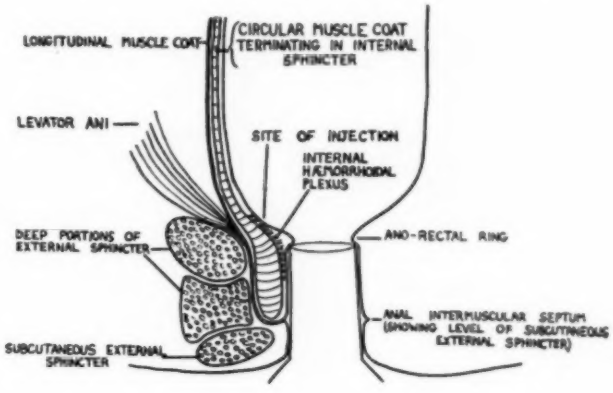
LONGITUDINAL MUSCLE COAT
CIRCULAR MUSCLE COAT TERMINATING IN INTERNAL SPHINCTER
LEVATOR ANI
SITE OF INJECTION
INTERNAL HAEMORRHOIDAL PLEXUS
DEEP PORTIONS OF EXTERNAL SPHINCTER
ANO-RECTAL RING
ANAL INTERMUSCULAR SEPTUM (SHOWING LEVEL OF SUBCUTANEOUS EXTERNAL SPHINCTER)
SUBCUTANEOUS EXTERNAL SPHINCTER

Fig. 2. Sagittal section showing position of proctoscope when the anorectal ring is visible. Note level of subcutaneous external sphincter and position of internal hemorrhoidal plexus.

When the piles reach the first stage of prolapse, the patient usually feels something slip through the anus, and return into the rectum. There may be slight pain at this stage. Finally, when the hemorrhoids remain continually prolapsed, bleeding may occur apart from defecation, due to trauma or engorgement. When prolapsing hemorrhoids have developed gradually, the patient experiences no pain because the sphincter muscles have gradually stretched and accommodated themselves. Should, however, a mass of internal piles prolapse suddenly, pain is severe, due to sphincter spasm, and later to thrombosis and infection. A prolapsed internal hemorrhoid gives rise to a discharge of mucus, and pruritus ani may result. Mental depression is a marked feature of the case, and it is gratifying to observe the remarkable improvement in the patient's mental condition after successful treatment.

COMPLICATIONS

When an internal hemorrhoid remains prolapsed it may become congested and thrombosed, due to trauma and infection and the accompanying contraction of the sphincters. Ulceration, infection, and gangrene may follow and in rare instances, infection has spread upwards and fatal portal pyemia has occurred. The perianal cuff of skin and the lining of the lowest portion of the anal canal become markedly edematous.

Thrombosed and infected internal hemorrhoids usually resolve and may undergo spontaneous cure, or in the majority of cases, a marked diminution in the size of the piles results. Repeated attacks of thrombosis may give rise to the production of a fibrous polyp.

DIAGNOSIS

When pain is a prominent complaint, a careful search should be made for other associated conditions, such as fissure or abscess. Diagnosis is rarely made from the history alone. Unless the hemorrhoids covered by bright red mucosa, are seen prolapsed, it is essential to pass a proctoscope into the rectum to arrive at a diagnosis. The appearance of prolapsed hemorrhoids may be changed by thrombosis, ulceration and infection. Digital examination alone will only reveal the presence of a pile if it is thrombosed, or if there is a marked redundancy of slightly thickened mucous membrane.

When a two inch proctoscope is passed into the rectum and withdrawn slowly, a

prominent muscle ring, the anorectal ring, will be seen closing down immediately above the end of the instrument as it

Fig. 3. Proctoscope has been withdrawn further than in Figure 1, and shows internal hemorrhoids producing irregular closure of the anal canal.

passes downwards into the anal canal. As the proctoscope is further withdrawn, this ring contracts down above it in a more or less even manner, like a smooth umbrella ring (Fig. 1). When internal hemorrhoids are present, they bulge into the proctoscope below the level of the upper part of the ring, and the anal canal closes in an irregular manner, somewhat like a camera shutter (Fig. 3).

There are, as a rule, three primary hemorrhoids corresponding to primary divisions of the superior hemorrhoidal artery, situated as described by Miles, at 3, 7, and 11 o'clock (12 o'clock being in the midline anteriorly). The size of the hemorrhoids and the degree of prolapse are better judged when the patient strains gently as the proctoscope is slowly withdrawn. It is important to exclude the presence of other conditions such as carcinoma, epithelioma, fissure, submucous or other types of abscess, fistula, proctitis, papilloma, polypi and hypertrophied anal papilla. The upper part of the rectum should always be examined with the finger and sigmoidoscopy must be carried out before the patient is finally discharged.

TREATMENT

There are three methods of treatment with definite indications.

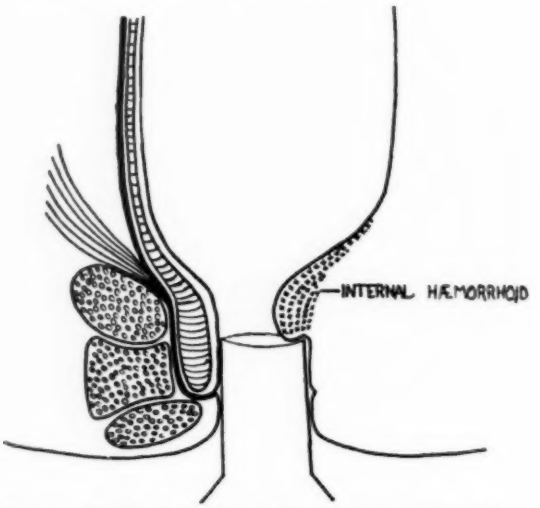

Fig. 4. Sagittal section with the proctoscope in a lower position. Compare this with Figure 2.

1. *Palliative.* Palliative treatment should always be carried out when the hemorrhoids are thrombosed and infected. Not only is it dangerous to inject or operate upon such piles owing to the great risk of spreading the infection, but because, after the "attack" has subsided, either the patient has cured himself, or a few injections at a later date will suffice. For these cases, rest in bed is essential, preferably with the foot of the bed raised. In cases where the prolapse has suddenly come down, reduction into the rectum should be gently carried out, if necessary after the application of an ice pack. Compresses of lotio hydrargyri perch 1–2000 are applied, and frequent hot baths ordered. Mild laxatives, such as confection of senna, milk of magnesia or mineral oil are given.

Palliative treatment is also advisable in very mild cases of internal hemorrhoids, with only slight bleeding, especially if there is rectal dyschezia or congestion of the rectal mucosa.

2. *Injection Treatment.* Though the treatment of hemorrhoids by injection has a very important place in treatment, it is the considered opinion of many authorities that only in certain selected cases does a

cure result, and even in many of these, recurrences are not uncommon. Careful observation in the Out-patient Department of St. Mark's Hospital clearly indicates its limitations. The selection of cases is most important since dangerous complications may occur, or the results be disappointing.

When small uncomplicated hemorrhoids, whose only symptom is bleeding, are present, injection almost always effects a cure. Occasionally, severe hemorrhage is encountered, which at first sight would appear to indicate operative interference, with the necessity of a blood transfusion. Immediate injection of the bleeding hemorrhoids will usually control the hemorrhage at once.

Hemorrhoids which prolapse on defecation or on proctoscopic examination may also be injected. The chemical inflammation resulting from submucous injection high above the piles, fixes the mucosa and by contraction of the fibrous tissue, tends to draw up the hemorrhoid into the rectum. It is impossible in such cases to be sure of the response to the injection, and it is necessary to warn the patient that the prolapse may not be cured.

When the hemorrhoid remains permanently prolapsed, or is of the intero-external type, and also in cases of huge hemorrhoids, injection is not only inadvisable, but is useless. Occasionally, when there is only one hemorrhoid which is continually prolapsed in a patient in whom operation would be undesirable, a high injection above the hemorrhoid may be done. In such a case, it is important to keep the patient recumbent for a few days under observation, because the hemorrhoid might swell considerably and become strangulated by the sphincters. "Local infection is a definite contraindication to injection."

Hemorrhoids, complicated by other conditions, such as fissure, etc., should not be injected until these conditions have been treated.

The method used at St. Mark's Hospital is the submucous injection of 5 per cent phenol in almond oil, high at the base of the pile.

The knee-elbow position or the inverted (Hanes) position is the most satisfactory, since in this position the rectum becomes distended with air after introduction of the proctoscope and the prominent anorectal ring may be localized.

The correct site for injection is just above this ring because the highest part of the internal hemorrhoidal plexus is situated just above this level (Figs. 1 and 2).

The oily solution is then injected slowly in the submucous layer and the mucous membrane will be seen to be lifted up and become paler. The solution should be injected until a swelling occurs, in which tiny capillaries can be seen on a background paler than normal and slightly coloured yellow by the almond oil. If a dead white area appears during the injection, the needle is lying too near the mucous membrane, and must be withdrawn immediately. Ulceration will occur if the solution is injected too superficially. As the needle is withdrawn some of the solution is injected along its track.

These injections are made at points corresponding with the position of the hemorrhoids, though in actual fact, the solution spreads freely under the mucosa so that the whole circumference of the lumen has been treated.

Usually, 3 to 5 c.c. above each hemorrhoid is necessary, but it depends on the laxity of the mucous membrane. Sometimes, 6 to 8 c.c. must be injected.

On the first occasion, it is wise to give one injection only, since severe reaction, both local and general, may sometimes occur. I have had several patients who have had a mild febrile attack, after injection of the almond oil solution. If the stronger solution containing glycerine (mentioned later) be used instead, then there is no general reaction.

The second injection is given in about ten days. If a good reaction has occurred, the mucous membrane feels leathery both to the palpating finger and to the needle.

When little or no reaction has occurred, the injection is repeated at the same site and in the position of the two other hemorrhoids, but if the mucous membrane is now tough, a smaller injection of 2 to 3 c.c. is given at a slightly lower level through the soft mucous membrane. The patient is again seen in fourteen days, and should there be a good reaction high up, no further injections by this method should be given.

It is sometimes found that though there is a good reaction in the upper part of the pile mass and the submucosa above it, the lower part of the pile may still be prominent. In these cases, one final injection deeply into the centre of each pile, of 20 per cent phenol in equal parts of glycerine and water is given with advantage. Only 3 to 5 minims of the solution are injected at one site. This solution must never be injected high up immediately under the submucosa.

The effect of the injections is very variable; it may be permanent, and in a suitable case the patient should be free of symptoms for one year or more.

3. *Operation.* When operation is necessary, it is undoubtedly a much surer method of curing prolapsing internal hemorrhoids than injection. Though recurrences occur on rare occasions, in most instances the patient is cured or is free from symptoms for twenty years or more.

Though there are many hemorrhoidectomy operations described, it has been found that the modern modification of the simple ligature and excision operation, recommended by Salmon one hundred years ago, gives the most satisfactory results.

It is impossible in this short article to describe in detail the operation. Some of the more important facts only will be given. The rectum and sigmoid colon are emptied by adequate preoperative treatment. The anesthetic used is a low spinal anesthetic, using 25 to 50 mgms. of procaine hydrochloride. This has been found very satisfactory, since it precludes postoperative vomiting, coughing and straining, which produce edema of the perianal skin.

The left forefinger is inserted into the anus and the anorectal ring felt. With aseptic precautions, 10 c.c. of a solution of local anesthetic in oil of the formula

	Per Cent
Procaine base	1.5
Butyl-para-aminobenzoate	6
Benzyl alcohol	5
In sterilized almond oil	

are injected through a single puncture 1½ inches behind the anus in the midline. Five c.c. are injected on either side in a fan-like manner into the external sphincter muscles and finally into the subcutaneous fat around the anus, and also into the ischiorectal fossa. This solution is then gently massaged into the tissues. The anal canal and perianal skin are thoroughly cleaned with weak antiseptics and swabbed with surgical spirit (Figs. 5 and 6).

The sphincters are not dilated but the hemorrhoids are delivered by gently everting the skin at the anal verge with a pair of plain dissecting forceps. The hemorrhoids are seen in turn and each seized with artery forceps. Each pair of forceps in turn is laid in the palm of the hand and gentle traction applied, and the index finger introduced along the forceps into the anus to the level of the upper part of the subcutaneous external sphincter.

If there is no associated external skin tag, a pair of straight blunt ended scissors cuts, at the mucocutaneous junction, towards the tip of the inserted finger. Mucous membrane and submucosa only are left undivided between inserted finger and the end of the scissors. The hemorrhoid has now been dissected free. The hemorrhoid should not be dissected up further than the level of the tip of the finger, otherwise postoperative constriction might occur.

A curved round bodied needle threaded with No. 2 chromic catgut now transfixes the pile at the upper level of the incision and the pile is securely ligatured. The two remaining hemorrhoids are treated in a similar manner. When bleeding has been

controlled, the hemorrhoids are removed, leaving an adequate stump distal to the ligature.

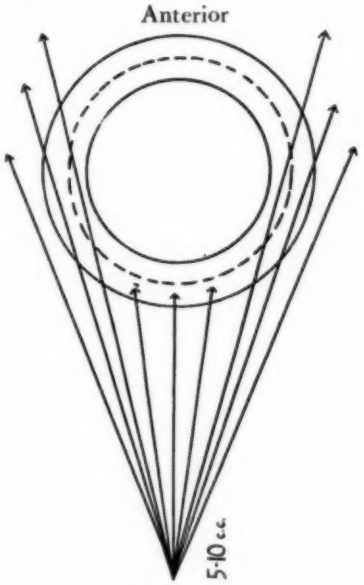

Fig. 5. Method of injection of oily anesthetic solution.

As stated, the plexus lies at the anal verge and is covered with skin. This type of hemorrhoid is therefore sensitive.

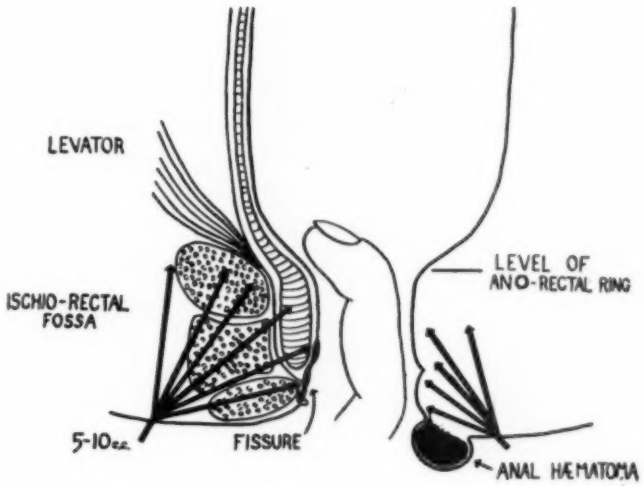

Fig. 6. Showing depth of injection; also the method of infiltration for removal of an anal hematoma.

In the case of intero-external hemorrhoids, the external and internal portion of the composite pile are dissected up and removed together.

It is important to remove freely any redundant skin at the anal verge, leaving wounds running radially towards the anus. These raw areas should not be sutured. A small wick of vaseline gauze is finally placed in the anal canal and a firm dressing applied.

Careful preparation, the use of oil soluble anesthetics, and extremely gentle operating, allows this operation to be performed with little or no after-pain.

The bowels are moved on the third day with an olive oil and gruel enema, and daily hot baths instituted. Daily antiseptic moist dressings are applied to the anus.

It is important to pass a finger into the anal canal after the ninth day to anticipate any constriction. This should not occur if the operation is properly performed.

EXTERNAL HEMORRHOIDS

External hemorrhoids result from dilatation of the external hemorrhoidal plexus.

External hemorrhoids present two main types—

a. Thrombosis of part of the external hemorrhoidal plexus, giving rise to a very painful visible swelling at the anus;

b. Hypertrophied anal skin tags which result either from repeated attacks of thrombosis or from infection in the anal canal or due to trauma from scratching, etc.

External hemorrhoids exist apart from the internal variety but may be associated with them.

Acute Thrombosed External Hemorrhoid (Anal Hematoma). As the result of straining either at stool or work or sitting on a cold seat, congestion of the external plexus may occur, resulting in actual rupture of a subcutaneous vein at the anus. Thrombosis occurs and the blood clot may be both under the skin and in the lumen of the vein.

The patient experiences sudden pain at the anus and feels a swelling. On examination, a tense rounded blue swelling is seen under the skin. There may be several thrombotic piles present. The swelling is acutely tender and there may be associated

muscle spasm. Very occasionally, a linear induration from it may be felt passing up in the anal canal. This is due to thrombosis of a connecting vessel lying in a column of Morgagni.

TREATMENT

When the swelling is seen soon after its occurrence, it should be excised. This is easily done by infiltrating the subjacent sphincter with an oil soluble anesthetic and removing the skin over the clot. The clot is removed and a search is made for other smaller clots which should also be removed. A small flat wound is left which should be kept clean and dressed daily. The patient has no after pain whatsoever owing to the prolonged action of the anesthetic solution (Fig. 6).

HYPERTROPHIED ANAL SKIN TAGS

Fibrous skin tags at the anus may not give rise to any symptoms other than difficulty in keeping this region clean. The skin surface may become abraded and infection, with edema and tenderness, and abscess formation, sometimes results.

TREATMENT

These skin tags may be excised in the same manner as the acute thrombotic variety. In old cases, the application of lotions diminishes the swelling.

Liquor Plumbi Subacetatis fort	1 drachm.
Cow's Milk	7 drachms.

Lotio Plumbi cum Opio	4 parts.
Surgical Spirit	1 part.

It is important to remember that other cutaneous conditions occur at the anus. These include perianal warts, condylomata, primary chancre and epithelioma. Furthermore, an edematous skin tag may be due to a fissure or an inflamed crypt.

SUMMARY

A short practical account is given of—

1. The clinical types of hemorrhoids; their causation, symptoms, and methods of treatment.
2. The technique of injection treatment is described and illustrated.
3. The ligature and excision operation and the injection of oil soluble anesthetics are presented.

INJECTION TREATMENT OF INTERNAL HEMORRHOIDS

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THE injection treatment of hemorrhoids is an office procedure depending for its success on the exact placing of suitable amounts of well tested sclerosing solutions. The injection must be submucous and above or proximal to the mucocutaneous junction. Proctoscopic examination, if possible to 25 cms., must precede treatment, and of course a summary physical examination is advisable.

HISTORICAL

One hundred years ago Long, in England, injected ferric chloride directly into nevi to produce sclerosis. Thirty years later Morgan, in Dublin, applied the method and the solution to piles. Shortly afterwards another Dublin surgeon, Abraham Colles, whose name is given to the well known fracture, used ferric chloride in treating a case of hemorrhoids by injection. In the United States, Mitchell of Clinton, Illinois, in some manner hit on the use of a solution containing 33 per cent phenol in olive oil. Subsequently, he is said to have sold his secret to any person able to pay his price and thus loosed a plague of itinerant "pile doctors" who wandered all over the North American continent using phenol solutions varying up to 95 per cent in strength. Andrews of Chicago, a surgeon of repute, got hold of Mitchell's secret and collected and published the results in over 3000 cases.

Naturally enough, considering the exponents of the remedy, some of the accidents were blood curdling. But the secret was out and in the hands of the medical profession, with the usual result. The hasty and inexpert quickly dropped the method with loud and harsh criticism; the more patient continued, and gradually two schools arose over a period of years. Both schools favored the method, but differed on a point of technique. Briefly, the "strong" group used solutions above 20 per cent phenol, in small amounts, with the aim in view to cause sloughing of the piles, while the "weak" or sclerosing group used solutions of between 5 and 20 per cent phenol, and aimed to produce sclerosis. It is interesting to note that the descendants or successors of the opponents of injection treatment are still with us, while the advocates of injection have become more numerous. The method has undergone many modifications, but it may be said to have become fairly standardized. The "strong" sloughing method has become almost obsolete, leaving the field to the exponents of the sclerosing method who used phenol or quinine and urea in 5 per cent solution.

PATHOLOGY

Following injection, as shown by microscopic sections, there occurs an aseptic inflammatory reaction, which is followed at the end of five or six days by intravascular clotting and the gradual supervention of fibrosis.

INDICATIONS

For the beginner, it is wise to limit this method to uncomplicated internal hemorrhoids, and best of all, to cases of simple bleeding without prolapse. In the hands of the experienced, injection of suitable sclerosing solutions may be done where there is considerable prolapse with or without bleeding. Fissure and fistula must be considered as contraindications, and it is well to remember that large external tags complicating internal hemorrhoids will usually prevent a really satisfactory result being obtained by injection.

EQUIPMENT

Any ordinary firm table will do, as the treatment can be carried out in the knee-chest or lateral positions, though with greater facility in the Hanes position. A good light is essential, and may proceed from a head lamp, a floor lamp, or a small light attached to the speculum.

There is a large assortment of specula from which to choose. In a general way, it may be said that the occasional operator would do better with a set of one type, while the specialist will, of course, recognize the need for a greater variety of types, sizes and lengths. It is my opinion that the beginner would do well to confine himself to a Kelly speculum of medium length and size.

In the matter of the needle to be used, many types have been introduced, the main feature of which is a short, sharp tip set in a stout shaft so that penetration beyond a certain depth is difficult. With the same end in view, other needles have a knob near the point. This type of special needle is really a crutch for poor technique. It is more important for the operator to repair his technical defects than to expect a needle to save him from error. Properly used, a plain spinal puncture needle is adequate. It should be mounted on a syringe of at least 5 c.c. capacity, with a lock joint and fitted with finger grips or rings. The bevel of the needle point is of little importance, though sharpness is desirable.

Of the many solutions which have been introduced since Morgan first used ferric sulphate, two are in common use and give eminent satisfaction. Quinine and urea in 5 per cent solution has been used extensively and with satisfaction, notably by Terrell. Phenol in oil is a much older preparation and has had a world wide test. In proper dilution, 5 per cent in almond oil, it is a very satisfactory preparation, will stand for a long period without deterioration, and when expertly employed is practically free from complications. Occasionally a 10 per cent phenol solution will be found necessary in resistant or recurring cases.

TECHNIQUE

The old method of injecting piles was to produce prolapse by an enema or previously administered cathartic. Each pile was then injected with a drop or two of "strong" solution, the piles reduced, and the patient dismissed. In many cases this gave excellent results.

In the modern method, no disturbance of the gastrointestinal tract is created. There is no preparation of patient, rectum or anal canal other than verbal assurance that the treatment is not associated with pain. The patient is placed in a suitable position, digital examination is done, and any prolapsing piles are replaced. A speculum, as small as is consistent with adequate visualization, is introduced, and the hemorrhoids inspected. If it is apparent that bleeding has been occurring from any one of the hemorrhoids, that one is selected for injection. The end of the speculum is so manipulated that a fold of pile is raised up at its proximal (anatomically) end, and the needle is introduced into the raised loose part so that the point lies under the mucosa. The phenol solution is now injected without producing any blanching of the mucosa and the upper end of the pile can be seen to swell. When a network of vessels, or the "striation sign," can be clearly seen on the swollen area, enough has been injected. The exact amount of phenol solution injected is not of vast importance, though the operator should read off for his record the amount used in order to gain an idea of what may be required for the average pile in the average case. The needle is withdrawn, the speculum is removed, and the patient is told that he may anticipate no trouble, but that if the piles have previously prolapsed they may rarely do so following the injection, and in such event he should return them without delay.

In a few days another pile may be similarly injected, and so on at intervals until each pile is the site of a definite induration. Injections are now suspended; the patient is symptomless, indeed, bleeding and prolapse usually cease after the first injection, and he is requested to report for observation from time to time, or if there is any recurrence of bleeding or prolapse.

There are many methods of phenol technique other than the above, and good results are obtained by those skilled in them. One favorite method is the injection of the hemorrhoidal ring by using 2 c.c. of phenol 5 per cent in each of the four quadrants at one sitting, and the subsequent placing of suitable amounts as indicated. Quinine and urea in 5 per cent solution may be used in general in a manner similar to the use of phenol, except that smaller amounts are used, 0.5 to 2 c.c. being generally sufficient to cause adequate sclerosis at each point of injection.

COMPLICATIONS

Sloughing is the result of too strong solutions or of intramucosal injection. If blanching of the mucosa occurs around the needle, injection should be stopped immediately at this point, as the wrong level is being used and a slough is practically inevitable. Emphasis must be laid on the necessity of placing the sclerosing solution in the submucosa, and nowhere else.

Hemorrhage only occurs following a slough. Abscess has been reported, but has not occurred in my experience. It is probably due to technical defects. Prolapse following injection has been emphasized by previous writers, and though unacquainted with the condition I have always advised about its possibility when dealing with a patient at the first injection.

General sepsis and pyelephlebitis have been described, but are not found in the reports of any modern expert.

CONCLUSION

The treatment of internal hemorrhoids by injection was introduced about seventy years ago, and has been widely applied. After a period of trial, and in this country exploitation by quacks, it has survived and has become fairly standardized. Many slight differences of technique are found today, but in general, dilute solutions are used and injections are spaced out. Symptomatic relief occurs immediately, and the recurrence rate is in the neighborhood of 10 per cent.

The method is far from a fool proof cure, but it can fairly be offered as an office substitute and a time and expense saving method for those unable or unwilling to accept surgery for uncomplicated bleeding or prolapsing hemorrhoids. The method is exacting on the operator, but when properly done is easy on the patient, and in its results in suitable cases is almost equivalent to surgery. Further, relapse can be easily treated, and in my experience patients show no unwillingness to have an occasional "repeat" injection.

PRURITUS ANI*

REVIEW OF 131 CASES FOLLOWED OVER AN EIGHT YEAR PERIOD

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THAT anal pruritis is a condition which at times baffles the general practitioner, the proctologist and the dermatologist is due chiefly to the following circumstances: (1) it is a symptom to which the doctor gives "too little thought and the patient too much"; (2) in its early stages, anal pruritus is ignored and relief is sought only when it has become chronic and after much physical and mental torment; and (3) the physician often makes a blind diagnosis without a thorough and careful history and a general and rectal examination. The latter is the first essential of treatment.

The 131 subjects reported in this paper were those whose presenting complaint was anal pruritus. A large group of patients who also complained of an "itch" or irritation about the anus, but whose chief complaint was pain or rectal bleeding, are not included in this study. As noted in Table 1 there is a marked preponderance of males over females and also that pruritus ani is a relatively rare condition in the colored race, in spite of the fact that about 8 per cent of our clinic patients are colored.

TABLE 1

Sex	Number	Per Cent	Per Cent Clinic Patients
Male	109	83.2	67.2
Female	22	16.8	32.8

Pruritus ani is a symptom and not a disease. It should not be considered as a diagnosis, but, like rectal pain or hemorrhage, a symptom of some underlying cause. Various classifications have been made of pruritus but to me the simplest one is that based on etiology.

1. Pruritus may be caused by or may be accompanied by every known rectal disease, such as carcinoma, colitis, polyps, hypertrophied papillas, hemorrhoids, fissure, fistulas.

2. It may be a manifestation of a general or constitutional disease, such as diabetes, nephritis, uric acidosis, malaria, tuberculosis, liver disease and the menopause.

3. Itching may be due to irritation from clothing; as dyed underwear or tight clothing. Under this heading might be included personal uncleanliness and excessive sweating.

4. Pruritus ani may be a reflex from diseases of the bladder, prostate, uterus, ovaries or vagina—vesiculitis, cystitis, trigonitis. In women one finds frequently a pruritus ani resulting from a profuse vaginal discharge. In the patients, if a rectal examination is negative, the treatment of the pruritus will be that of the gynecological condition.

5. Many skin diseases may recur around the anus, such as eczema, herpes and lichen simplex.

6. Parasites such as pediculi, ringworm and threadworm (Oxyuris vermicularis) may cause pruritus ani.

7. Pruritus ani may be on a dietary or allergic basis; strawberries, seafood, spices, alcohol and tobacco are frequent offenders.

8. Rectal constipation is probably the most common cause of anal pruritus, and one that is frequently overlooked or not considered. In this series of 131 cases whose

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chief complaint was itch, on digital and anoscopic examination, 114 revealed that the ampulla was either filled or partially filled with feces. Rectal retention was demonstrated in spite of the fact that the majority of these patients gave no history of constipation. It is our belief that many of these so-called idiopathic cases previously mentioned in the literature properly fall into this group. In these patients much can be done by early treatment with the simplest measures, especially before the condition becomes chronic and the skin changes become marked.

Much has been written concerning the role of bacteria in the cause of pruritus. Dwight Murray considered the streptococcus fecalis to be the infection organism; Others have ascribed the colon group as a causative agent in the pruritides. While no bacteriological research has been done at our clinic, the author believes that the majority of workers in proctology and bacteriology do not concur in this thought.

In many instances of pruritus ani of long standing, there is no doubt but that a "vicious cycle" is established. The pruritus, originally being due to some simple cause as excessive sweating or rectal constipation, starts insidiously, the scratching, however, causes the skin changes and increases the severity of the dermatitis.

Characteristic appearance of the skin around the anus shows it to be thrown into numerous deep folds radiating from the anal orifice. If moisture is present, the skin is white, soggy and macerated, with scattered small areas where the skin has been denuded of epithelium by scratching. In some cases the skin is dry and scaly, in others there are cracks or furrows which extend up to the anal mucous membrane. In stout individuals a real fissure may extend along the posterior median raphe and in man along the median raphe anteriorly to the scrotum. In protracted cases, the skin loses its elasticity and becomes hard, thick and leathery, most probably due to scratching, infection being secondary.

The pathological changes in cases of long duration have been described by Buie and his workers at the Mayo Clinic, showing proliferative changes in the epidermis, thickening of the prickle cell layer and often some dilatation of the superficial vessels and lymphatics. Fibrosis in the connective tissue occurs in cases of long standing but no changes are seen in the cutaneous nerves. Cocci may be found just beneath the ulcerated regions, but not under intact epidermis.

On the first visit to the clinic, patients with pruritus have a history taken and then a thorough examination is made of the anal and perineal regions, followed by a complete anoscopic and sigmoidoscopic examination. Frequently, because the rectal ampulla is clogged with feces, this latter examination cannot be done until a cleansing enema is given. Before returning for a second visit both urine and blood Wassermann examinations are made and where indicated blood chemistry is also done.

The rule at the clinic is to find the cause, which in numerous chronic cases is not always done until after weeks or months of observation. Whether or not the cause of the itching has been determined, its symptomatic treatment must start immediately even though only palliative, while the treatment of the causative condition is being carried out.

Four cardinal points are impressed on a patient when treatment is started:

1. Avoid scratching as much as possible. Impress each patient with the fact that the more they scratch, the longer the treatment will take and the greater will be the damage to their skin.

2. Keep the parts clean, washing with plain warm water after every bowel movement.

3. Keep the parts dry by means of a dusting powder. For this we advise patients to use common ordinary cornstarch two or three times a day and after defecation.

4. The rectal ampulla must be "kept clean." Patients with rectal constipation are instructed to take either an epsom salts

enema or an enema with plain water, preferably at night, before retiring. It has been my experience in pruritus ani, that mineral oil should be avoided because of the leakage.

Either 10 per cent iodine in glycerine or compound tincture of benzoin is applied locally. In fissures, 10 per cent silver nitrate or ichthyol in glycerine is applied. Ointments are rarely prescribed, although numerous anti-pruritic ointments have been used in the treatment of this condition. In this series of cases, we have used ointments in only 6 cases.

X-ray irradiation has been advocated in the treatment of pruritus ani, but the necessity for its use has not been proved, although 2 of the patients in this series had received *x*-ray therapy previously. It is generally accepted, that patients who have received *x*-ray irradiation are poor subjects for the subsequent surgical removal of any existing rectal pathology.

INJECTION METHODS

It can be safely stated that we have been liberal and unbiased in trying the various solutions which have been advocated for subcutaneous injections for the treatment of pruritus ani, aiming to obtain either the obliteration of the tissue spaces and the channels filled with irritating fluid that are alleged to be present in severe pruritus, or the production of cutaneous anesthesia. Table II lists the solutions used.

TABLE II

	Cases	Number of Injections
1. 1–3000 sterilized hydrochloric acid Hanes' method	2	2
2. Absolute alcohol (Stone)	8	18
3. 5 per cent phenol in oil in perianal region	20	33
4. Benacol (Yeomans, Gorsch, Matheisheimer)	30	48
5. Patient's whole blood injected in perianal region	2	3
6. Quinine and urea—½ per cent	2	2
7. Triple distilled water (Bacon)	1	2
8. Anucaine	52	158
9. Nupercaine in oil	1	3

The technique of each advocate has been followed in these injections. While the number of cases has been limited in which some of these solutions were used, the best results have been obtained with anucaine and we have used this exclusively for the last year. The objection to the use of some of these solutions has been the pain after injection. In some of these early cases more than one solution was used.

Anucaine acts as a local anesthetic for a period varying from four days to three weeks. No untoward results have been noticed from its use, although we have seen 2 cases of induration over the area injected which lasted for about a month but did not produce any abscess. Sloughing was not seen in any case in which anucaine was used. Frequently patients complain of pain over the injected area one or two hours after injection which subsides after a warm sitz-bath.

SURGERY

We have resorted to local surgery in 48 cases of the series, as shown in Table III, but none of the patients have been hospitalized. It must be remembered that frequently each case had more than one operation performed, dependent on the condition present.

TABLE III

	Number of Cases
1. Removal of skin tabs or hypertrophied skin folds	30
2. Excision of external hemorrhoids	21
3. Fissurectomy	12
4. Removal of hypertrophied papilla	10
5. Removal of polyps	6
6. Incision and drainage of abscess of posterior triangular space	2
7. Undercutting operations	2

RESULTS

In a condition such as pruritus of the anal region, the accurate evaluation of results is not easy owing to the lack of cooperation on the part of the patients and their tendency to discontinue treatments.

Only those patients have been considered cured where the skin changes were entirely cleared and the itch was present no longer. Failures were classed in those patients in whom itch persisted, whether or not any appreciable change was found in the perianal region.

Of the 78 patients considered cured, 12 have had a recurrence of perianal itching. Of these only 4 showed any appreciable skin changes. Upon questioning the 12 patients with recurrences, they all admitted a "let down" in their rectal hygiene but the itching subsided when they resumed cooperation.

Table IV

	Number of Cases	Per Cent
Cured	78	59.5
Improved	20	15.3
Failure	33	25.2
Total	131	

Type of Treatment Employed	Cases	Per Cent
Cured		
1. Rectal hygiene and local treatment	19	24.5
2. Rectal hygiene, local treatment and injection methods	35	44.8
3. Rectal hygiene, local treatment, injection methods and surgery	24	30.7
Total cured	78	
Improved		
1. Rectal hygiene and local treatment	1	5
2. Rectal hygiene, local treatment and injection methods	9	45
3. Rectal hygiene, local treatment, injection methods and surgery	10	50
Total improved	20	

It is interesting to note the number of visits patients made to the clinic before they were pronounced cured. The average was 15 visits, the minimum being 6 and the maximum being 142 visits. Of the improved cases we have one patient who made 189 visits during this eight year period and while she does not complain of any itching for the past year, she still has skin changes which does not answer our criteria of a cure. Of the patients classed as failures, the number of visits ranged from 1 to 22.

No attempt is made to enumerate all the etiological factors in these 131 cases, because many of these patients have more than one cause. In 14 cases or 9.35 per cent, however, no rectal pathology could be detected other than rectal constipation.

Table IV gives a resume of our cases and the type of procedure we followed.

In 18 of the failures no diagnosis was made as to the cause of the pruritus, as the patients did not return to the clinic for further study. Of the remaining 15 failures, 7 had injection treatment and 8 had injection treatment plus local surgery. In this last group, 2 patients were diabetics and 2 had a four plus Wassermann.

CONCLUSIONS

There is sufficient evidence in this series to warrant the following conclusions:

1. Rectal constipation is one of the most common causes of pruritus ani and most of the cases previously reported as idiopathic fall into this group.

2. Pruritus ani can be cured or improved if one persists in finding the cause and eradicating it, thereby breaking up this so-called vicious cycle of scratching.

3. If conservative measures, including local surgery, fail to give relief of any existing rectal pathology, then injection of anucaine is frequently beneficial.

4. The importance of rectal hygiene is stressed.

REFERENCES

Bacon, Harry E. *Tr. Am. Proctol. Soc.*, (May) 1936.
Buie, Louis A. Mayo Clinic Monographs, 1931.
Hanes, Granville S. *Tr. Am. Proctol. Soc.*, p. 1, 1922; p. 122, 1928.
Murray, Dwight. *Am. Jour. Surg.*, 34: 26–31, 1920.
Stone, H. B. *Johns Hopkins Hosp. Bull.*, 27: 242, 1916; *Surg. Gynec. and Obst.*, 42: 565, 1926.
Yeomans, F. C., Gorsch, R. V. and Mathesheimer, J. L. *Tr. Am. Proctol. Soc.*, 1927.

FOREIGN BODIES IN RECTUM

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THIS morning while I was having a bowel movement I suddenly felt a sharp, cutting pain in my rectum. It felt as though I was stabbed with a knife. Now (1:30 P.M.) there is only a soreness in my rectum. I didn't see any blood and it is the first time that anything like this has happened to me. My stool was not unusually hard this morning and as a general rule my bowels move twice a day.

This was the story of a man of forty-five years, told in the Proctological Clinic at the New York Polyclinic Hospital. There was nothing in his past history that had any bearing upon his story. This story would lead one to suspect a tear of the anal or rectal mucosa. An examination was made and an inspection of the anal region revealed nothing. A digital examination was then made and about 2 cm. above the anus a long, thin object was felt, apparently a bone. A speculum was inserted and with an alligator-jawed forceps a thin chicken-bone, about 5 cm. long was removed. More detailed questioning of the patient then revealed the fact that he recalled having eaten chicken three days before. Removal of the foreign body brought immediate relief and there were no subsequent symptoms.

This case is used in order to illustrate a class of cases where a foreign body may be present in the rectum without the patient being able to give any intimation as to the reason for its presence and in which the removal of the foreign body is a simple procedure.

I have been severely constipated for the last year. This began when I suffered from acute gastritis about a year ago. Night before last I was taking an enema when suddenly I felt a very sharp pain in the rectum, just as though I had torn something. I didn't see any blood but since then I have had a lot of pain whenever I sit down.

This was the story of a male of forty-seven years, who had been referred by the department of Cardiology in the New York Polyclinic Hospital to the department of Proctology. Further questioning failed to add anything important to the quoted history except that he had never had similar symptoms. The examination revealed upon inspection a rosette of hemorrhoids. A digital examination revealed a very marked sphincteric spasm. The finger inserted into the rectum also ascertained the presence of a sharp pointed bone-like projection in the anterior wall above the prostate.

A one per cent solution of novocaine was introduced into the sphincter to produce relaxation. Following this a speculum was inserted and a flat fish-bone about 2.5 long and 1 cm. in width, was removed. There were no after symptoms. This patient recalled having eaten fish three or four days before.

This case, while similar in most respects to the first case noted, differed in that, in order to remove the foreign body, it was necessary to administer a local anesthesia.

We now come to a class of cases that belong in a different category namely, where the patient knows that he has swallowed a foreign body and recognizes that this has become a foreign body in the rectum as soon as symptoms develop. Such a case came to the writer about seven o'clock one evening with the following story:

Night before last while eating dinner, I swallowed a chicken-bone. It did not bother me and I forgot about it until about a half hour ago when, as I started to eat dinner I suddenly felt a sharp pain in my rectum. I

guess it is the chicken-bone. It still hurts and it feels as though there is something in my rectum although the pain is not as sharp as at first.

Inspection revealed nothing, but upon digital examination a small sliver of bone could be felt just above the sphincter muscle and by crooking the examining finger the foreign body was expelled with the finger. It was a small chicken-bone, apparently about 2.5 cm. long and a couple of millimeters in thickness.

Then there is the class of cases in whom the foreign body in the rectum has been introduced through the anus. The following is an illustration:

A patient at Bellevue Hospital told Dr. Cowett the following story:

> I have been having trouble with my prostate a long time which necessitated my going to a doctor twice a week to have my prostate massaged. I was running low in funds so I devised a way to massage my own prostate. I cut off eight inches of a broom handle, then four inches from the rounded end I cut the broom handle to half its thickness, leaving about four inches to insert into the rectum and the thinner four inches was a handle for me to grip. I have been massaging my prostate with this, and this morning while doing this it broke at the point where I had made the broom handle thinner. The other piece has remained in my rectum.

Examination revealed the presence of the broken piece in the rectum, and under general anesthesia and free dilatation of the sphincter the broken piece was removed.

From the brief illustrations given it will be seen that foreign bodies in the rectum fall under the following categories:

1. Where the foreign body has been introduced through the mouth without the patient's knowledge;

2. Where the foreign body has been introduced through the mouth with the patient's knowledge;

3. Where the foreign body has been introduced directly into the rectum through the anus. Under this latter heading might be added that a foreign body might be present in the rectum, introduced through the anus without the patient's knowledge although this occurrence is rare.

4. There is yet one class of foreign bodies which may occur and which may not have been introduced either through the mouth or through the rectum but have been formed within the body. These are the so-called stercoliths or fecal calculi. One would expect to find them in cases of chronic constipation. The usual composition is a mixture of inspissated feces and inorganic salts and the nucleus a foreign body such as a fruit stone although the presence of the latter is not essential. One of the peculiar and characteristic symptoms of the presence of this condition is the involuntary passage of liquid stools. Diagnosis, of course can be made only by a careful rectal examination. When the nature of such a condition is ascertained it is better to attempt to soften and break up the mass than to attempt to remove it en toto. A favorite method to break up such a mass is a solution of hydrogen peroxide introduced as an enema. As the peroxide soaks into the mass, bubbles of gas form in its substance and break it up. Having broken the mass, an enema removes the debris.

SYMPTOMS

Symptoms of a foreign body in the rectum are first and foremost, pain. The natural reaction of the rectum to the presence of a foreign body is to expel it. This effort is undoubtedly what causes the onset of pain, particularly if the foreign body is sharp, or, if not sharp, of sufficient size to prevent expulsion. Bearing in mind that only the lower 2 inches of the rectum is rich in sensory nerves, the presence of pain is a good indication as to the location of the foreign body. Other symptoms may be; bleeding, due to trauma caused by the foreign body, or obstruction to free passage of the fecal current because of the size and nature of the foreign body. It must also be borne in mind that owing to the sensory nerve distribution which is common to the

lower rectum, urethra, neck of the bladder and vagina, that there may be pain in any of the parts just mentioned. It is even possible for pain to be referred to the inner side of the knee or the hip-joint because of this same nerve distribution. If the foreign body should be very large and exerts sufficient pressure upon the posterior wall of the rectum, this pressure upon the sacral plexus might cause a variety of pains.

DIAGNOSIS

This should be simple. A good history is important. Digital examination may reveal the foreign body, but should it not, a speculum, preferably one with a light, may reveal the foreign body. If neither of these methods succeed and if one is convinced that a foreign body is present, the radiograph must be the next resort.

TREATMENT

This will depend entirely upon the nature of the foreign body. Of course its removal is the first consideration. In planning the procedure for removal the important fact to be borne in mind is that the removal should be accomplished with a minimum of trauma. The larger and more irregular the foreign body the more serious is this danger. Unquestionably the first step is to produce a relaxation of the sphincter, which may be most readily accomplished by an infiltration of the sphincter muscle with some local anesthesia, such as novocaine or procaine. If the foreign body is small and not deeply embedded it may be extracted with the index finger without causing any unnecessary damage. If, however, this cannot be done, the wise procedure is to introduce a speculum. With the patient in the left knee-chest position, a Humpheries speculum or if that is not available an ordinary Sims speculum will give a good exposure of the lower end of the rectum. Should such a speculum not give an exposure sufficiently high then it will be necessary to use some tubular speculum with an auxiliary light, such as the Lynch speculum. Through this the body may be grasped with a forceps and brought down through the speculum. Should the foreign body be larger than the lumen of a speculum or multiple such as, for instance many pieces of broken glass other procedures may be necessary. Continuous irrigation with water is suggested, or the introduction of gauze in the latter instance hoping that the small spicules of glass will adhere to the irregular mesh of the gauze. However, instances may arise where more drastic surgery will prove necessary, even to the point where the abdomen may have to be opened and by pressure from above, the foreign body may be expelled through the anus. It may be of passing interest at this point to mention a few of the varieties of foreign bodies that have been found in the rectum.

Morand, in his memories of the Academy of Surgery in Paris, tells of a monk who, to cure a violent colic introduced a bottle into his rectum with a small opening in its mouth by which its contents, drop by drop, could enter the intestines. The bottle could not subsequently be removed and it was necessary to secure a boy with a small hand to extract the bottle. Hevin tells of some students who introduced the frozen tail of a pig into the anus of a French prostitute. The bristles were cut short and being lubricated with oil, this tail was introduced with great force into the rectum, allowing a portion of the tail to protrude. Great pain followed. Efforts to remove the tail proved unsuccessful. On the sixth day Marchettis succeeded in removing it by passing a hollow reed into the rectum outside of the bristles and then removing reed and tail together. Studsgaard mentions a smooth stone, 17 cm. long, weighing 900 grams which a peasant had introduced into his rectum to relieve prolapse.

A convict at Brest, put a box of tools up his rectum. He died seven days later. At postmortem the box was discovered in the transverse colon. It was a cylinderical box of sheet iron covered with skin, 6 inches long, 5 inches broad and weighed 22 ounces. There are records of many more various and curious objects found in the rectum

but the few that have been mentioned will indicate the variety. Because of the ingenuity used in the removal of a foreign body the following may be of interest: A man was a victim of rowdy companions. The following day, while searching within the rectum to determine the cause of certain unusual symptoms, he located something that felt like the edge of a glass. Manual manipulations failed to dislodge the intruder, so he tried a thumb forceps which snipped off a particle of the edge of the glass which left a serrated edge. The following method or removal was then used:

Pieces of gauze were dipped in plaster-of-Paris paste, and inserted into the hollow glass with a long dressing forceps through a speculum until the glass was packed overfull. The last strip was sufficiently long to leave more than 12 inches free for traction. Within half an hour the plaster was solid. As traction was made, small particles of loose hardened plaster preceded the glass, and fragments and splinters were incorporated with them. No difficulty was experienced in bringing the glass to the sphincter. This was dilated with a vaginal speculum, and the foreign body was withdrawn with but little resistance and no bleeding. The object proved to be a common 5 ounce "high-ball" glass. The victim, a marine engineer, returned to duty the next day.

SUMMARY

1. A foreign body in the rectum may come to anyone's attention at anytime, but in most instances it will be a small object, swallowed with food, such as a fish-bone or chicken-bone.

2. Diagnosis is not difficult because of the almost uniform exactness of symptoms, viz., a sudden, sharp stabbing pain near the anus and the subsequent localization by an examining finger, of a foreign body.

Treatment is removal, bearing in mind the problem of trauma to the tissues.

PILONIDAL CYSTS: EXCISION AND PRIMARY SUTURE IN AMBULATORY PATIENTS*

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AMONG the lesions cared for by the general surgeon and the proctologist, there are few conditions which give such unsatisfactory end results as the treatment of pilonidal cysts and sinuses. Following the customary procedure of excision en bloc and packing, the incidence of recurrence is high, the period of hospitalization is long, the subsequent period of redressing is extended, and frequently the end result is a large painful scar. It is the purpose of this paper to report further[1] upon a method of treatment of pilonidal cysts and sinuses in ambulatory patients which has given us permanent cures in 92 per cent of our cases, and an average healing period of 17.4 days from the time of operation. By this method of treatment our patients have lost an average of two days from work.

By definition, a pilonidal cyst is a congenital anomaly consisting of a cyst or a sinus lined with stratified squamous epithelium and frequently containing hair. It is located in the midline just above the coccyx. It does not communicate with the rectum and usually is not recognized until after puberty, when attention is focused upon it by the symptoms of infection.

Probably the first description to be found in the literature was written in 1847 by Dr. A. W. Anderson[2] of Gray, Maine. He stated that his patient was a "young man, aged twenty-one years (who) said he had a scrofulous sore on his back which he believed would use him up." From the "ulcer" Dr. Anderson extracted hair. Hodges,[3] writing in 1882, suggested the name pilonidal cyst. In the European literature, it is usually referred to as sacrococcygeal cyst or sinus. Other terms that have been used are pilous cyst, sacrococcygeal fistula and sacrococcygeal dermoid.

ETIOLOGY

Many theories have been offered to explain the etiology of pilonidal cysts. Warren,[4] in 1867, gave the first explanation of the etiology of these lesions when he suggested that they might be the result of "hairs becoming diverted from their normal direction (due to pressure) and inverting themselves in the follicle." Terrillion,[5] in 1882, proposed two theories: first that the cysts might be the vestiges of a "posterior umbilicus," and second that they might be the result of a spina bifida, "a son plus faible degré de development," involving the skin only. In 1892 Lawson Tait[6] proposed that the sinus was due to a "cicatrix of the spina bifida by which the human tail has been lost." Stone,[7] in 1931, drew an analogy with the preen gland of birds, in which he compared the tuft of feathers at the mouth of the gland with hairs protruding from a sinus.

At the present time, there are three chief schools of thought regarding the etiology of pilonidal cysts. The first considers that they arise from remnants of the neural canal. Two explanations for this have been suggested. The earlier theory, that proposed by Feré,[8] suggested that closure of the neural canal might not be complete and bits of its lining might be cut off and later develop as a sequestration cyst. The more recent and more popular theory was proposed by Tourneaux and Herrmann[9] and has been elaborated by Wendelstadt[10] and Mallory.[11] Briefly, these writers maintain

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that in the development of the neural canal its threadlike tip is left attached to the skin at its caudal end. As the fetus develops, the spine grows more rapidly than the skin, pulling the attached end superiorly and posteriorly so that it describes a U around the coccyx. The tip of this filum terminale finally reaches the level of the third sacral vertebra. After the fifth fetal month the structure atrophies, but Mallory found remains of it in full term fetuses. Its epithelium may develop to form cysts and, as Perman[12] states, may regain its original squamous character.

The second theory was suggested by Lannelongue.[13] He noted in the embryo that the skin over the coccyx is in firm juxtaposition to the bone, with no intervening mesoblast. In later development, the surrounding mesoblast gives rise to the abundant subcutaneous tissues forming the nates. This causes a dimple to be left over the coccyx. Exaggeration of this dimple would cause a sinus, and overgrowth of epithelium at the mouth might lead to cyst formation. Oehlecker[14] modified this theory by adding the factor of disproportionate growth of skin and spinal cord with the result that the skin is pulled anteriorly and caudally.

The third theory considers that pilonidal cysts are due to imperfect coalescence of the lateral halves of the body. It was probably first discussed by Lamadrid[15] in 1872; it has had the support of Bland-Sutton[16] and other writers and is the most popular theory among the clinicians.

Arguments against the neural rest theory are: (1) the general absence of nerve tissue in the pathological sections from pilonidal cysts; (2) the universal presence of squamous epithelium as the cyst lining; (3) the absence of any dermoid structures other than hair and sebaceous material. Case reports of meningitis originating from an infected pilonidal cyst,[17,18] and the report of a case where spinal fluid gushed out during excision of a cyst[19] have been offered as arguments against the second and third theories. Fox[20] noted that according to Oehlecker's theory the tract should be directed downward instead of its universal cephalid direction. A very interesting paper[21] has been presented within the past year, suggesting that there may be two etiological possibilities: neural rests giving rise to pilonidal cysts, and invagination of epithelium producing sinuses and more rarely cysts. Fox disagrees with this. In his paper he traces the evolution of ectodermal invaginations through a series of embryos. He shows that while the coccygeal medullary vestiges do exist they do not form pilonidal sinuses; if they do appear, they form tumors. He believes that pilonidal sinuses are due solely to ectodermal invaginations carrying with them all their normal structures.

FREQUENCY

The frequency of admissions for pilonidal cysts in a general hospital has been given by Dulligan[22] as 0.1 per cent. Breidenbach and Wilson[23] have recorded the incidence at Bellevue as 0.06 per cent of all admissions. Kline [24] in a general hospital for veterans quoted the frequency at 0.5 per cent. Patients presenting themselves with pilonidal cysts have constituted 0.9 per cent of the admissions to the Surgical Out-Patient Clinic of the Hospital of the University of Pennsylvania during the past six years. Excision and primary suture of pilonidal cysts has constituted 1.2 per cent of operations performed in that clinic. This high frequency may perhaps be accounted for by the large number of young adults attending the University of Pennsylvania and also by the known interest of the writers in this condition.

The white race is the most frequently afflicted with pilonidal cysts. No cases have been reported in Mongolians or American Indians and but 6 cases have been recorded in the Negro (Smiley,[25] 1; Fansler and Anderson,[26] 1; Breidenbach and Wilson,[23] 4). Males are more frequently subject than females. Ravdin and Johnston[27] have collected 505 cases from the literature, of which 75 per cent were males. Numerous

writers have mentioned the higher incidence in hairy individuals. Ottenheimer[28] states that they occur in obese individuals

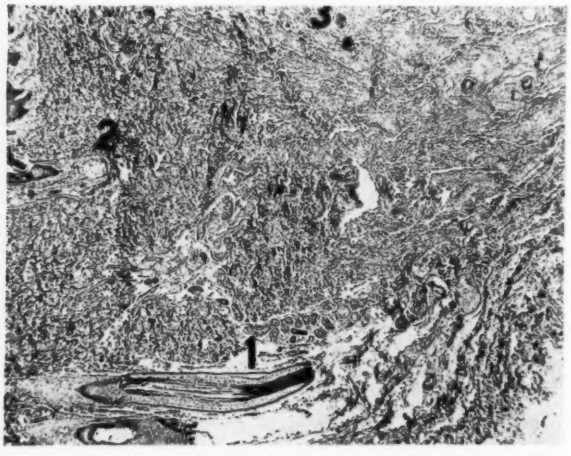

Fig. 1. Section through the deep portion of a pilonidal cyst, showing hair follicles (1), sweat glands (2) and foreign body giant cells (3). Note the well formed squamous epithelium forming the cyst surface in upper left hand corner.

with a suggestion of endocrine imbalance. This has not been the experience of the present writers.

A hereditary tendency towards pilonidal cysts has not been proved. Breidenbach and Wilson were able to find only 5 patients in 288 who had a family history of these lesions. However, Mechling[29] reported sinuses in twenty-three year old twins, and Smiley[25] noted them in a father and his three children.

PATHOLOGY

Associated congenital lesions are unusual. Frank Glenn[30] roentgenogramed 19 patients with pilonidal cysts and found only 2 cases of spina bifida occulta. Breidenbach and Wilson state that they have never seen hair follicles, sebaceous or sweat glands in any of their specimens. They believe that the persistence of an erroneous observation of Crone[31] accounts for the description of these structures in the literature. Review of the sections from all specimens removed at the Hospital of the University of Pennsylvania in the past year shows but one case in which hair follicles and sweat glands have been observed in the depth of a sinus. A photomicrograph of a section from this case is presented (Fig. 1).

SYMPTOMS

The presenting symptoms are usually those of acute inflammation. A history of recurrent abscess formation is frequent. More rarely one finds a long continued discharge and pruritis as the only symptoms. Still more unusual is the patient who presents himself because of a lump above the anus. Trauma is nearly always the factor in initiating the inflammatory reaction in a previously quiescent cyst.

DIAGNOSIS

The diagnosis is simplified if one keeps the condition in mind. The index of suspicion is high when there is an abscess in the midline over the sacrum and above the anus. A probe introduced into a pilonidal sinus will not pass into the rectum, but, in contrast, will take a cephalid and anterior course. The extraction of hair from the sinus is diagnostic. Differential diagnosis must be made from perirectal and ischiorectal abscesses, from fistulas in ano, from infected sebaceous cysts, from furuncles and many other less frequent conditions. In the writers' experience, the most difficult differential diagnosis has been from sacrococcygeal dermoid. Recently, a patient presented himself with a history of four previous operations supposedly upon a pilonidal sinus. He presented a moderately acutely inflamed area in some scar tissue over his sacrum. The lesion was exquisitely tender and fluctuant. It was incised and drained under the impression that it was an infected pilonidal sinus. At this time the operator observed that purulent material was coming from a sinus which passed through the sacrum to its anterior surface. The deep sinus was packed with iodoform gauze and the patient sent for a roentgenogram (Fig. 2).

TREATMENT

Considerable controversy has arisen in the literature with regard to the most successful method of treating pilonidal cysts and sinuses. The treatments most commonly employed have been: (1) excision with packing of the wound, permitting healing by granulation; (2) excision with partial suture and packing or drainage; and (3) excision and primary suture. Recently, Rogers and Hall[32] have proposed cautery excision with packing and healing by granulation. The accompanying table gives a comparison of these various types of treatment, tabulated according to the days in the hospital, days lost from work, length of healing period and results (Table 1).

In reviewing the histories of these cases it became apparent that a necessary hospitalization of one or two weeks with a healing period of four to twelve weeks, was too long a period of disability for the treatment of a superficial infected sinus or cyst. The difficulty seemed to lie in the fact that the operation of excision was performed on an infected cyst or sinus, which made primary infection of the resulting wound almost certain and, because of the location of the wound, secondary infection very probable. In addition, an accurate excision of the entire infected tract was made more difficult by the presence of inflammation. It seemed logical then to treat the infection and accompanying inflammation first, and later to perform an excision of the sinus tract.

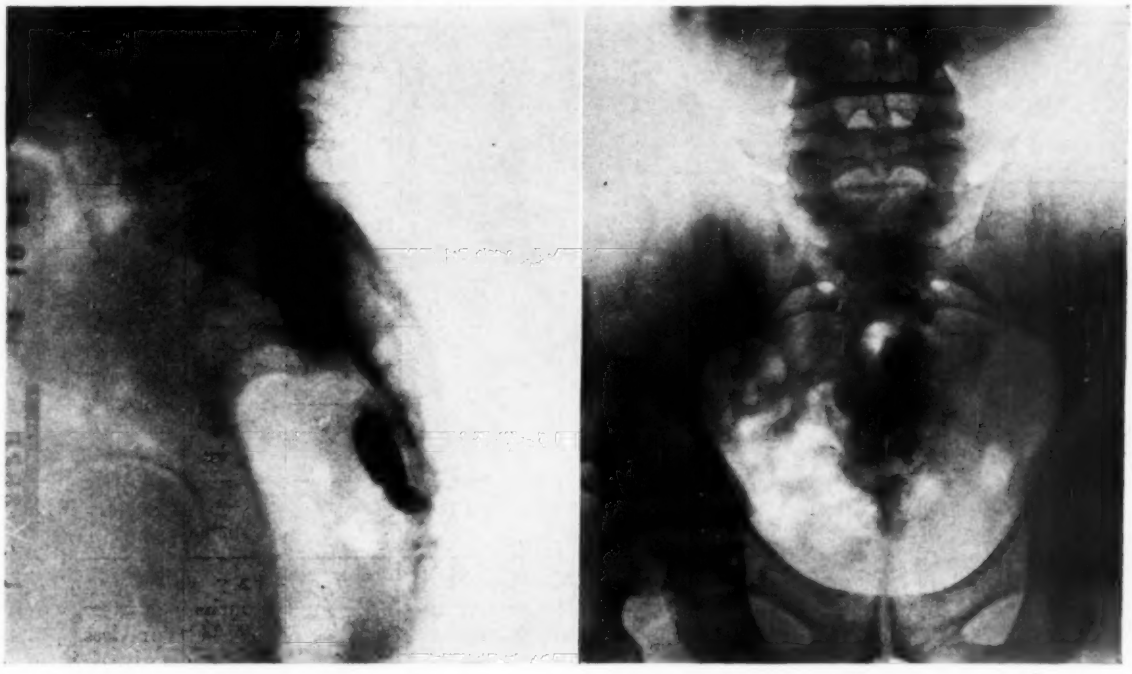

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FIG. 2. *X*-ray picture showing sacrococcygeal dermoid packed with iodoform gauze. This cyst extended by a narrow opening through the sacrococcygeal joint and produced a smooth, painful, fluctuant swelling over the lower sacrum. It had become painful due to recent trauma. The cyst was operated upon with the mistaken diagnosis of pilonidal cyst and represents one of the rare lesions of this region which may be confused with pilonidal cysts.

TREATMENT OF INFECTION AND INFLAMMATION

Our treatment then consisted of incision and drainage of the infected sinus or cyst under local anesthesia as a primary procedure, and usually applications of hot wet dressings twice daily during the first forty-eight hours after operation. The loose gauze packing was removed on the third day after incision and healing was permitted to take place. In more than half of our cases,

adequate drainage was obtained by dilating the sinus opening with a hemostat, or by the simple application of hot wet dressings.

TABLE I

Author	Type of Treatment	Days in Hospital	Average Days from Work	Average Healing Period	Per Cent Cures
Breidenbach and Wilson	Excision and packing	8	at least 8	6–12 weeks	94. (132 operations, 32 patients followed, 30 cures)
	Excision, suture, drainage or packing	9.1–11.6	9–12	6–12 weeks	64.
	Excision and suture	8.4	8–9	6–12 weeks	56.
Rogers and Hall	Excision; partial or complete closure or packing	10.9–13.4	11–14	2.7–3.5 months	56.–61.
	Cautery excision, packing	1 day for 34 of 50 patients	7	2.7 months	100. (29 cases, 8 months or less postoperative)
Ferguson and Mecray	Excision and packing* or Lahey operation	6–12	14	4–10 weeks	50.
	Excision and primary suture	0	2	1–3 weeks	92.

* Ferguson, L. K. *Ann. Surg.*, 101: 469, 1935.

With sharp rakes as retractors, the incision is deepened to isolate the sinus opening entirely. An Allis forceps is then applied to close the sinus orifice and to serve as a tractor on the tissue to be removed. With the tissue constantly on tension, the dissection is then carried upward, surrounding the sinus and cyst. The line of separation from fascia overlying the sacrum is easily recognized, but the lateral separation must be made by the scalpel. In cases where there are secondary sinus openings, these are dissected out before attacking the main cyst.

After removal of the cyst and sinus, a clean wound remains with normal fatty tissue on the sides and sacral fascia in the base of the wound. Closure is effected in two layers. The first layer is of No. 00 plain catgut, four or five interrupted sutures placed so as to include the fatty tissue on each side of the wound and the sacral

As a rule, the wound was entirely healed in two to three weeks. The patients were ambulatory throughout this period of treatment and most of them continued to follow their usual daily activities.

TECHNIQUE OF EXCISION AND PRIMARY SUTURE

After the primary infection had been controlled and the inflammatory reaction had completely subsided, the cyst and sinus tracts were excised and the wound closed by primary suture. The technique of the operation of excision is simple. A wall of novocain-adrenalin is injected by infiltration around and under the sinus tract and cyst. The incision is then begun in the midline over the sinus tract and continued downward to surround the sinus opening.

fascia at its base. These sutures are all inserted before any are tied, because the approximation of the wound obtained by tying them as they are inserted makes it difficult and even impossible to accurately insert the last two sutures. This layer of sutures obliterates dead space in the base of the wound. The skin is approximated and dead space is further obliterated by the use of mattress sutures of alloy steel wire tied over gauze rolls (Fig. 3). Usually, several interrupted sutures of fine wire are used to aid in the further approximation of the skin edges. A pyramidal-shaped pressure dressing of gauze is applied and held in place with firm adhesive strips.

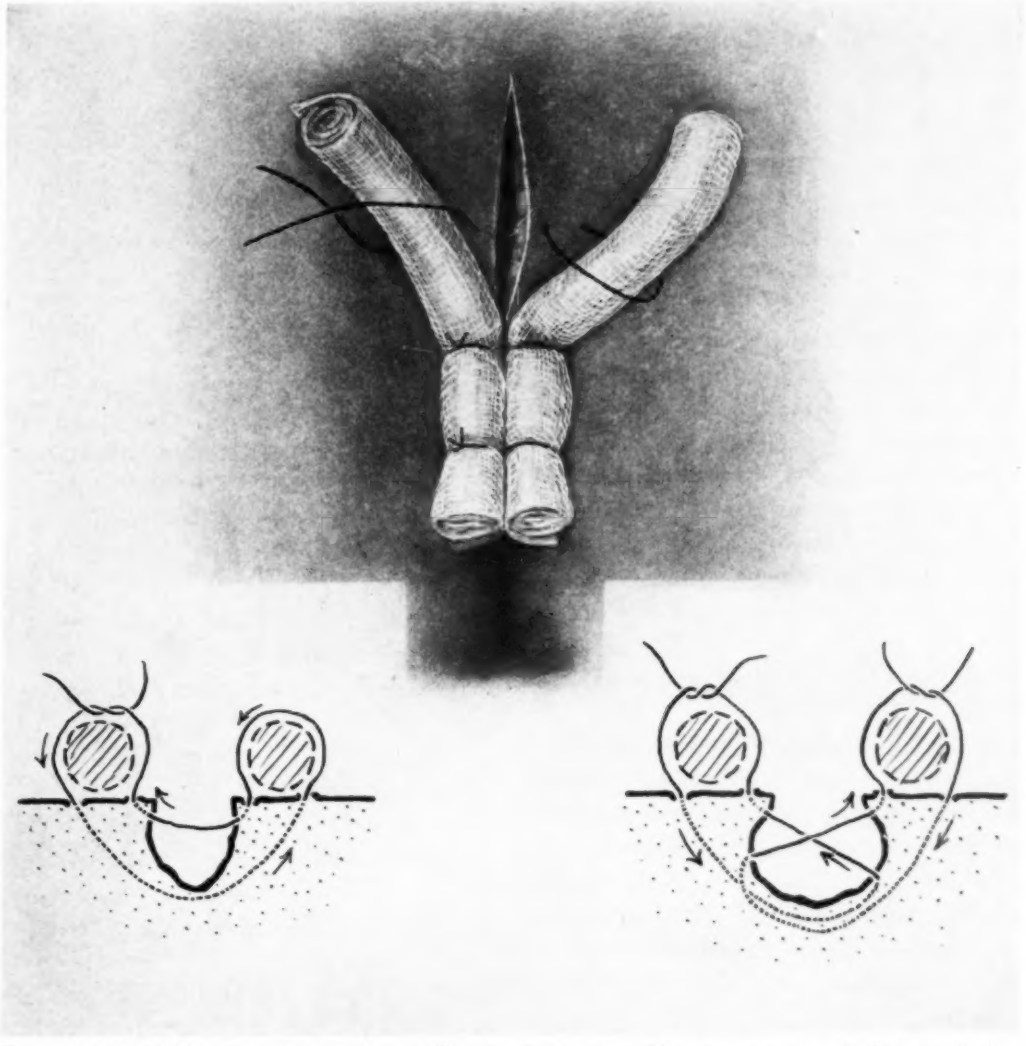

Fig. 3. Method of closure of wound to obliterate dead space. Mattress sutures of alloy steel wire inserted and tied over gauze rolls as shown. Occasionally slight undercutting of the wound edges is necessary to permit good closure.

Our experience has shown that primary union is dependent on the obliteration of dead space and the prevention of serum collections, and to this end, pressure on the wound is further obtained by placing the patient on his back on a litter or operating table for an hour after operation. He is then permitted to go home. Our patients are usually given three 1/6-grain tablets of morphine sulphate to be taken by mouth every third hour if necessary. As a rule, they are not used; most patients experience more discomfort from the adhesive strapping than from the operative wound.

Dressings are inspected on the third day and at this time the interrupted sutures in

the skin are removed. These wounds are prone to become moist and macerated, and the skin around the sutures frequently becomes infected. There is often a redness and induration of the wound at this stage which subsides readily. Gauze moistened in 70 per cent alcohol solution has proved a most satisfactory dressing. On the sixth day the wire mattress sutures are removed and another alcohol dressing applied. The wound is kept under observation for another week. Occasionally, there are small serum collections in the wounds, which usually do not appear until after the mattress sutures are removed, and in many instances drainage of the serum will take place through the stitch holes. Wounds are treated with alcohol dressings and are opened reluctantly, only if spontaneous drainage does not occur. If there is a tendency to maceration of the skin about the wound, zinc oxide ointment is often of value.

This method of therapy has distinct advantages.

1. It is possible to perform the operation under local anesthesia, thus making easily possible the ambulatory care of the patient. If adrenalin hydrochloride (8 drops of the 1:1000 solution to the ounce of 1 per cent procaine) is added to the infiltrated solution, the resultant operative field is practically bloodless, making possible a more rapid operation and a more accurate dissection.

2. The absence of inflammation and the use of adrenalin permits not only a complete and careful excision of the entire tract, but also it is possible to preserve a considerable amount of the normal surrounding fatty tissue, which must be sacrificed if the excision is performed while the cyst is the seat of an acute inflammation. The dissection is carried out without the necessity of injecting the tract with any colored solution. There is no difficulty in differentiating the denser tissue with smaller fat lobules which surrounds the sinus and cyst, from the normal adipose tissue with larger fat lobules which lies adjacent to it. In addition, leakage of the colored solution into the wound often confuses rather than aids the dissection. The absence of inflammation makes it necessary to remove only a narrow cylinder of tissue, thus making it possible to remove the entire sinus tract and cyst and still perform a primary closure without leaving dead space.

RESULTS

Thirty-seven patients with pilonidal cysts have been treated as outlined. Five of these were hospitalized for the first twenty-four hours after operation; these were either students who lived alone in dormitories or patients who lived more than an hour's ride from the hospital. All of the others were ambulatory throughout their period of treatment.

Primary Treatment. The cyst was incised and drained under local anesthesia in 11 patients. In the remaining 26 cases, the infection was controlled and the inflammatory reaction subsided by either dilatation of the sinus or the simple application of hot wet dressings.

Immediate Operative Results. In all cases excision and primary suture were performed. Two wounds had to be reopened because of infection and 2 partially reopened due to trauma. Fourteen wounds had a slight serous drainage and were treated for three or four days with alcohol dressings. The healing periods in the 37 cases are given in Table II.

Table II

Healing Period in Days	10 or Less	11–15	16–20	21–25	28	60	84
No. of cases.....	13	8	10	3	1*	1*	1†

* Wounds partially opened by trauma.
† Wound reopened because of infection.

In all but 4 cases the wounds were healed and the patients discharged from our care within three weeks after operation; in more than half the cases, postoperative care was

necessary for less than two weeks (Fig. 4). Postoperative visits averaged 7.6, including those patients with wound complications.

A B

FIG. 4. A, pilonidal cyst with secondary sinus opening; B, same patient twelve days after excision of the cyst and sinus with primary suture of the wound; healing by primary intention.

More than half of the 37 patients had five or less postoperative dressings.

Permanent Results. Of the 38 operations (one patient was operated on twice), the results are known in 37 cases. There were 3 frank recurrences, one of which has been reoperated and is now healed more than three years. Two patients had an occasional slight serous discharge from small sinuses, which persisted for several months; these have since completely healed.

All but one patient was able to be traced in a follow-up examination. Thirty-four patients are well and free of symptoms. Eight of these have been operated upon less than one year and are therefore too recent for a final report; the other 26 patients have been well for one to four years. Four of the 26 complain of occasional pain on sitting; it is significant that these patients are those whose wounds were opened either because of infection or trauma.

ECONOMIC CONSIDERATIONS

Primary excision and primary suture in ambulatory patients has a distinct recommendation, if the cost of the treatment to the patient is considered. We have estimated that our method of care costs about one-tenth as much as the treatment by excision and packing. There is saved the cost of at least eight days bed and board in the hospital with other incidental hospital fees. The short healing period and the relatively few postoperative visits save private or clinic fees. The few days lost from work, an average of two days in 38 cases, as compared with ten or twelve days, prevent a loss of income. All of these are savings to be considered by the patient who is paying for his treatment, or by the hospital in cases of charity patients.

SUMMARY

1. A review of the etiology and pathology of pilonidal cysts and sinuses has been presented.

2. A method of treatment has been given, of which the essential details are:

a. Primary control of the infection and inflammatory reaction;

b. Excision of the cyst and sinus, when free of infection and inflammation, under local anesthesia;

c. Primary suture of the wound with care to obliterate dead space;

d. The patient is ambulatory throughout his period of treatment.

3. This method has given good permanent results (92 per cent cures) with few (3) recurrences. The patients had an average healing period of 17.4 days and an average of two days lost from work. The economic advantages to be derived from this form of treatment are pointed out.

REFERENCES

1. Ferguson, L. K. *Ann. Surg.*, 101: 469, 1935.
2. Anderson, A. W. *Boston Med. and Surg. Jour.*, 36: 74, 1847.
3. Hodges, R. M. *Boston Med. and Surg. Jour.*, 103: 485, 1882.
4. Warren, J. M. Surgical Observations with Cases. Boston, Tecknor and Fields, 1867, p. 192.
5. Terrillion, M. *Bull. et mém. de Soc. de chir. de Par.*, 8: 54, 1882.
6. Tait, Lawson. Transactions of the Congress for the Advancement of English Science. Dublin, 1877 (quoted from Terrillion).
7. Stone, H. B. *Ann. Surg.*, 94: 317–320, 1931.
8. Feré, C. *Bull. Soc. anat. de Par.*, 53, 1878.
9. Tourneaux, F. and Herrmann, G. *Jour. de l'anat. et de la physiol.*, 23: 498, 1887.
10. Wendelstadt, H. Dissertation, Bonn, 1885.
11. Mallory, F. B. *Am. Jour. Med. Sc.*, 103: 263, 1892.
12. Perman. *Langenbeck's Arch.*, 1895.
13. Lannelongue. *Bull. et mèm. Soc. de chir. de Par.*, 8: 185–194, 1882.
14. Oehlecker, F. *Ztschr. f. Chir.*, 197: 262, 1926.
15. Lamadrid, J. J. *Philadelphia Med. Times*, 3: 699, 1873.
16. Bland-Sutton, J. *Ann. Surg.*, 10: 81, 1889; *Jour. Anat. and Physiol.*, 20: 433, 1886.
17. Moise, T. S. *Surg., Gynec. and Obst.*, 42: 394, 1926.
18. Ripley, W. and Thompson, D. C. *Am. Jour. Dis. Child.*, 36: 785, 1928.
19. Weeder, S. D. *Ann. Surg.*, 98: 385, 1933.
20. Fox, S. L. *Surg., Gynec. and Obst.*, 60: 137, 1935.
21. Gage, Mims. *Arch. Surg.*, 31: 175, 1935.
22. Dulligan, P. J. *Am. Jour. Surg.*, 6: 554, 1929.
23. Breidenbach, L. and Wilson, H. L. *Ann. Surg.*, 102: 455, 1935.
24. Kline, L. B. *Med. Bull. Vet. Admin.*, 11: 241–246, 1935.
25. Smiley, K. E. *Am. Jour. Surg.*, 27: 289, 1935.
26. Fansler, W. A. and Anderson, J. K. *Minn. Med.*, 17: 146–147, 1934.
27. Ravdin, I. S. and Johnston, C. G. *Am. Jour. Med. Sc.*, 190: 280, 1935.
28. Ottenheimer, E. J. *Am. Jour. Surg.*, 21: 121, 1933.
29. Mechling, C. C. *J. A. M. A.*, 102: 367, 1934.
30. Glenn, Frank. *New England Med. Jour.*, 207: 554–556, 1932.
31. Crone, E. *Münchc. med. Wchnschr.*, 64: 521, 1917.
32. Rogers, H. and Hall, M. G. *Arch. Surg.*, 31: 742–766, 1935.

ISCHIORECTAL ABSCESS

A CONSIDERATION OF THE ORIGIN AND THE TREATMENT

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ISCHIORECTAL abscess almost invariably means that an anal cryptitis has been overlooked; for 90 per cent of all para-anal inflammatory disease is of non-specific origin and directly traceable to an acute cryptitis. Acute cryptitis does not present a complicated picture either for diagnosis or treatment, nevertheless the amazing frequency with which its disabling sequels enter the office and clinic must bring about a reconsideration of the problem.

Review of 100 consecutive cases of ischiorectal and pararectal abscess seen at the New York Post-Graduate Hospital rectal clinic, showed that 44 patients had as their chief complaint the discharge of pus from an already existing fistula or sinus varying in duration from two days to four years; 23 of these people had had one or more previous operations for abscess without relief. In questioning these people, it appeared that three factors must play a part in this picture: (1) delay on the part of the patient in consulting his doctor, (2) delay on the part of the doctor, and (3) incomplete therapy. Social taboos on the discussion of anal disease makes difficult the dissemination of information that might bring the patient to the doctor sufficiently early for the disease to be a simple problem. Neglect at this "golden period" of rectal surgery, however, is not altogether the fault of the patient, for not infrequently he tells the story of having consulted a doctor and of having been given a salve or a lotion for the tell-tale para-anal itch, a cathartic for his constipation and admonition to return in two weeks. Only too often it is apparent that a proper rectal examination had not been done.

Anal crypts form pockets at the bottom of each of the columns of Morgagni. They take origin in the transitional epithelium of the intermediate zone and therefore are lined by tubular glands, more usually known as anal ducts. The mouths of the crypts are in part protected by the folds and papillae of the columns.

Acute cryptitis is a primary inflammatory disease of the glands of the crypts. As the process continues the crypt becomes edematous and filled with pus. The papillae are swollen, elongated and even take on a polypoid character. Exudate forms a mat about the swollen papillae effectively sealing the mouth of the crypt, and the mechanism is completed for the formation of a submucosal abscess. *Para-anal itching and burning* appear early in the disease, for the purulent discharge is decidedly irritating. We often hear the mother say, "There is something wrong with Billy. He is always scratching himself." *Pain on defecation* appears at a later stage of the disease, that is, when abscess has formed; the cryptitis has become sealed off forming an intramural inflammatory mass.

The rectal examination will invariably expose a cryptitis or submucosal abscess. The patient should be either in the knee-chest position, with knees well separated, or well over in the left Sims position. The presence of hemorrhoids or fissure need not confuse the picture as they are incidental rather than causative in their relationship. The finger will elicit a single point of tenderness and possibly define the abscess as a mass the size of a pea. Direct examination by the use of an open speculum and a good light will complete the picture. This last procedure is essential to a proper

rectal examination and should never be omitted.

Treatment at this stage is relatively simple and decidedly satisfactory. Divulsion of the anal sphincter to admit five or six fingers should be done slowly so as not to tear the tissues. The abscess is incised in the long axis of the gut, the incision extending from the mouth of the crypt toward the anal orifice. The mucosal flaps of the abscess are resected to insure adequate drainage and to prevent any tendency to secondary pocketing. Follow-up visits to maintain a relaxed sphincter and a freely draining wound until the entire cavity is filled with granulations, will cure the disease.

The subacute and chronic cryptitis forms the channel of origin of ischiorectal abscess and fistula. Granulations and scarring effectively seal the mouth of the crypt so that the process is forced to extend deeper into the anal ducts or glands. The abscess, now more properly a column, reaches well into and beyond the muscle coats of the anorectal canal, and when rupture eventually occurs, it is into the highly susceptible pararectal space. The secondary abscess so evolved may be in the immediate pararectal tissue or at almost any distance into the ischiorectal fossa. One of two things may happen at this stage: (1) rapid accumulation of an abscess with rupture to the outside and the formation of a complete rectal fistula, (2) walling-off of the secondary abscess in the ischiorectal space with irregular drainage either into the rectum, or, and as eventually does occur, the formation of secondary channels and further foci of abscess. The second is obviously the more complicated because the fistula so formed is complex and may even be multiple in type.

Continued reinfection within the virtually non-collapsible ischiorectal fossa sets up a vicious circle. The infecting agent is retained in the isolated gland structures in and about the origin of the fistular tract. The persistence of these same glands keeps open the original tract to the anal crypt and therefore to continued fresh source of infectious material. The irregular channel becomes thickened by the repeated scarring and hyalinization, so that the healing process at best is slow and irregular. Pockets filled with chronic purulent debris form activating foci and are followed by secondary acute abscess formation.

The inadequacy of open drainage as a sole form of treatment for this complex picture is due to the non-collapsible character of the pathology and to the fact that the entire process is contained in a relatively rigid fossa. Excision of all source material, that is, of the entire tract, associated with wide drainage of the cavity, though apparently very radical, is the only complete cure for the disease.

Tuberculosis is the causative agent in approximately 10 per cent of ischiorectal abscess. Pulmonary tuberculosis can almost invariably be demonstrated by *x*-ray, and chest plates should be taken, if only for the protection of the surgeon, in all cases where there is a possibility of this disease. The patient with anal tuberculosis gives a story of repeated operations for abscess without success. Examination shows the granulations about the sinus to be puffy and rather watery in character. If such a patient has a chronic cough, look for tuberculosis as the cause of ischiorectal abscess. The fact must be borne in mind, however, that a chronic cough by no means indicates that the ischiorectal abscess must be tuberculous in origin. Surgery to be effective in this disease must completely remove all the granulomatous tissue.

Abscess of a pilonidal cyst will occasionally drain downward into an ischiorectal space. The recognition of the origin of this abscess and the line of the sinus is essential, for it would decidedly complicate an already complicated picture to open this abscess into the bowel. Complete excision of the pilonidal cyst and the tract is necessary to effect a cure.

Rectal diverticulitis is a rare cause of ischiorectal abscess. The mechanism in this instance is very similar to that of anal

cryptitis with abscess and rupture into the pararectal space. The depth and extent of the tract, however, modifies the treatment, and the case must be treated as an intestinal fistula passing through the ischiorectal space.

Fig. 1. Anal cryptitis forms the channel of origin of ischiorectal abscess and fistula. Note the exudative character of the disease, irregular scarring, and scattered persistent gland structure at the bottom of the crypt.

Fig. 2. The walls of the fistula are thickened by repeated scarring and hyalinization. The chronic purulent inflammatory disease is progressive and forms foci for secondary abscess and sinus formation.

Trauma as a cause of ischiorectal abscess is infrequent but nevertheless does occur. When treated immediately as a penetrating wound with adequate drainage, a cure may be expected without much difficulty.

Malignancy in the ischiorectal space will form an abscess, but the abscess obviously is of secondary importance and need not concern us in this discussion.

Anal infection as a focus of general toxic absorption comparable to disease of teeth, tonsils, appendix, or gall bladder, has received little consideration. Patients have lost their teeth, appendix and gall bladder in an attempt to relieve rheumatism and have failed because of undiscovered low grade anal cryptitis or even fistula. The routine medical examination should give the anorectal canal at least as much attention as the teeth and tonsils.

The treatment of ischiorectal abscess is not an office procedure. It must not be forgotten that 23 per cent of the cases of ischiorectal abscess that enter the Post-Graduate Hospital rectal clinic have had previous unsatisfactory operations which had served but to complicate the picture.

General anesthesia is to be preferred; gas oxygen or ethylene are adequate, and ether is rarely necessary. A small low spinal anesthesia gives excellent results, but the postoperative difficulties, particularly headache, complicate the picture; however, where a general anesthetic is counterindicated, parasacral block is preferable to the spinal.

Incision of the abscess completes the fistula. The extent and direction of the fistulous tract must be ascertained before further surgery is attempted, and this can best be done by the use of the flexible silver probe. If difficulty is encountered, the anal crypt involved can usually be located with ease, and the channel entered by a hooked probe from within the rectum. A complete divulsion of the anal sphincter is of course necessary to complete the above procedure. The fistula is grasped upon the probe and excised in its entirety by actual dissection. The sphincter muscles are preserved if possible, but if necessary one or even both

may be incised with little or no damage. If the incision through the sphincter is made at right angles to the muscle fibers, union will be reestablished without suture and without appreciable functional disturbance. The scar tissue forms an origin and insertion for the divided muscle. All tissue flaps and coverings of the wound must be widely resected so as to produce the effect of saucerization, and so that proper collapse may take place without secondary pocketing of infected material. A light iodoform gauze packing completes the procedure. Should pocketing occur at a later date, a secondary operation to complete the first must be performed.

Postoperative hospital care is simple, for the patient is comfortable and rapidly free of fever in spite of the radical surgery. After thirty-six hours an oil cathartic is given and in forty-eight hours the drains are removed. Regular low residue diet, mineral oil or agar-type cathartics and a daily sitz bath complete the routine.

After care of the rectal patient is prolonged, but to obtain a good result, it must be exacting. A well lubricated bougie is passed every day for the first week and three times a week thereafter until healing and epithelialization is complete. A small suppository of castor oil and balsam of Peru, equal parts, after each passage of the bougie, is very soothing to the patient. Periodic review is required for another six months to prevent a possible fibrous stenosis of the anus.

The more complicated fistulas of secondary horseshoe type must be dealt with as individual problems. One must keep in mind the warning of Miles, "it may be better to endure the discomfort of a discharging sinus rather than run the risk of permanent loss of control." This is particularly true when we realize that any form of treatment other than complete radical excision will do nothing but add to the complications.

Bacteriophage therapy is relatively untried in the treatment of pararectal inflammatory diseases. Cultures at operation usually show a mixed infection with Bacillus colon acidi lactici and green streptococcus as the predominant organisms. A potent mixed bacteriophage is available and might well prove of considerable value as an adjunct to surgery, more particularly in the postoperative care of the more extensive wounds.

SUMMARY

A review of 100 cases of ischiorectal and pararectal abscess showed that 44 already had fistular formation upon entering the clinic and 23 had had one or more incomplete operations.

The origin and pathology of pararectal inflammatory disease is traced from the relatively simple acute cryptitis to the complex picture of ischiorectal abscess and fistula.

Three factors appear to complicate the picture; (1) delay on the part of the patient; (2) delay on the part of the doctor and (3) incomplete therapy.

The principal sources of infection of the ischiorectal space other than that outlined, are tuberculosis, pilonidal cyst with abscess, perforated rectal diverticulitis, trauma and malignancy.

The entire excision of the fistular tract with widely open drainage is advocated as the desired form of treatment. Bacteriophage therapy as an adjunct to surgery is suggested.

REFERENCES

Hirschman, L. J. Focal infection of anal origin. *J. A. M. A.*, 97: 1609–1611, 1931.

Lockhart-Mummery, J. P. Fistula-in-ano. *Lancet*, 230: 657–660, 1936.

Miles, W. E. Anorectal fistulae. *Post-Grad. Med. Jour.*, 12: 319–326, 1936.

Rankin, F. W., Bargen, J. A., and Buie, L. A. Anal Infections. The Colon, Rectum and Anus. Philadelphia, W. B. Saunders Co., 1932, pp. 580–608.

Tucker, C. C. and Hellwig, C. A. Anal ducts: comparative and developmental histology. *Arch. Surg.*, 31: 521–530, 1935. Histopathology of anal crypts. *Surg., Gynec., and Obst.*, 58: 145–149, 1934.

RUPTURE OF MUSCLES AND TENDONS*

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CINCINNATI

UNLIKE fractures, which are an everyday occurrence, muscle and tendon ruptures are accidents which only occasionally come under the observation of the general practitioner. They may like fractures be direct, the effect of external trauma the impact of which is felt at the site of the muscle or tendon in question. But they are quite as frequently caused by a sudden poorly coordinated contraction of the muscle itself, or even of its antagonist, such as occurs when one is called upon suddenly to preserve his balance or escape a fall. Ruptures of this kind are known as indirect.

Since tendons form the insertion of muscles to their bony attachment, any disturbance of their physiology is linked necessarily with the muscles of which they are a part. When these tears sever the entire structure through its whole thickness, they are called complete ruptures; if they involve only a portion of it, they are partial ruptures.

Finally, we have to classify these ruptures into the traumatic and the so-called spontaneous or pathologic types, the latter being the result of a predisposition or of some pathologic condition such as arthritis, syphilis or senile degeneration. Occasionally a spontaneous rupture of a muscle or tendon occurs several months after some trauma that did not at the time produce this result. The patient may do nothing more than lift his hand or walk across the floor to bring on a pathologic rupture of one of these structures.

Symptoms vary with the extent and site of the rupture. The patient experiences a sudden pain, with loss or impairment of motion of the part. Swelling follows, with continuous pain, worse on motion, sometimes up to the limit of endurance.

Because of the greater blood supply, ruptures in the substance of a muscle give rise to extensive hemorrhages. When the tear is in the tendon, signs of hemorrhage may be less but the possibility of necrosis is more.

At operation, if this is done promptly, the ends of the tendon are frequently found in a frayed condition and may be covered with minute bloody spots. A small blood clot or an extensive hematoma may be found occupying the space between the torn ends. The ends may have separated widely through the pull of the proximal severed portion. If operation is delayed, this separation increases and fibrous tissue begins to fill in the intervening space, in some cases even exhibiting the characteristics of calcification, especially where there has been extensive necrosis of tissue.

Among our most frequent tendon ruptures are those of the hand, the sites of predilection being the flexor of the middle finger in its middle phalanx, the center of the palm, and the extensor of the thumb in its second phalanx. A complete rupture is the most serious injury that can befall a tendon on either the palmar or the dorsal surface of the hand, and such ruptures are of very frequent occurrence. If not sutured promptly the tendon is liable to remain permanently severed, with corresponding loss of function through adhesions or formation of new fibrous tissue which prevents approximation.

NECESSITY OF OPERATIVE MEASURES

Injured muscles should always be taken seriously in the early stages, because of the

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inability of muscle tissue to effect true regeneration. The time element is important, owing to the functional damage that results from Nature's attempts at fibrous repair if the rupture is neglected. The blood clot between the ends organizes and results in a fibrosis. The scar tissue thus interposed between the muscular elements will not only cause contraction and shortening of the muscle, but will also produce pain on movement through compression of nerve filaments in the muscle plates as the result of fibromyositis. When the rupture is at a joint, this scar formation inhibits motion and binds together all those planes of fascia which should permit of gliding, which is the very essence of a tendon's proper function.

Generally speaking, I incline therefore to view that complete tears should always receive operative treatment. This is not always the case with partial ruptures, where there is a maintenance of continuity. In partial ruptures perfect restoration of function may often result with simple rest of the part, followed by gentle massage to stimulate the blood supply and gradual institution of passive and active movements.

If the rupture is complete, we must operate. Ordinarily, if no infection is present, we go ahead promptly with the repair of the injury. In presence of infection, however, we often deem it wiser to wait for traumatic inflammation to subside. We open up the rupture and remove the hematoma, but postpone the sutures for one or two weeks, or even longer if necessary; for attempts at repair while infection is active will jeopardize results. They may entail another operation at a later time, under worse conditions, because more tissue will have been sacrificed through suppuration. This postponement not only gives Nature a chance to clean up the infection but has the added potential advantage of establishing local immunity and thus encouraging the healing process after operation. In cases where we pursue this waiting course, it is desirable, in view of the certainty that the tendon ends will retract more in the interim, to introduce a provisional suture in each of the cut ends to facilitate their identification later, thus obviating a long search for them when we are ready to repair them. The injured member is then placed at rest until the inflammatory condition subsides.

There is scarcely a muscle in the body that does not sometimes suffer a rupture. There is space here to consider only a few of the more important of these, with their appropriate treatment.

PROCEDURES

The common procedures in use for the repair of ruptured tendons are:

1. Tenorrhaphy, that is, the approximation and suture of the two severed ends of a tendon;
2. Reconstruction by lengthening (splitting or a silk thread);
3. Tenodesis, or implantation to a new point of attachment; and
4. Tendon grafting (transplantation).

Previous to the execution of any of these repair procedures, the original wound in the skin must be opened up completely and any infection present cleaned up. Extensive debridement and dissection of the tendon ends are important, especially if the rupture is in a finger or thumb. The skin incision must be ample in order to locate both ends of the severed tendon. In a rupture of the extensor pollicis longus it may be necessary to carry the incision far up toward the elbow before the proximal end is found, so strong is the pull of its attachment. Digital incisions must avoid the flexor surface of the finger and must not cross flexion creases at right angles. They should be made on the lateral margin of the fingers.

In all tendon operations great care must be taken to maintain the integrity of the vaginal ligaments of the tendon sheaths. Any blood clot or hematoma present must be thoroughly removed and aseptic conditions established.

Tenorrhaphy. When there is no important loss of substance, the two cut ends of the

tendon are brought together under conditions of strict asepsis and sutured together with some absorbent material, as chromic catgut, kangaroo tendon, or fine silk. Over a dozen different methods of tendon suture exist, all of them good. In digital work, the mattress suture is undoubtedly the strongest. Three such sutures are placed in each end, with the knots preferably tied and concealed between the two ends. Previous to suture, the ends, which are often severely fringed or frayed, must be cut clean with a razor to remove all traumatized tissue and to facilitate their approximation and coaptation.

Garlock[1] who has done important work on digital tendons, uses two fine straight needles on each end and carries his double line of braided silk mattress sutures obliquely through the entire thickness of the tendon, the two sutures interlacing with one another at every step and leaving a minimum amount of suture material exposed on the surface of the tendon until the needles finally come out through the cut surface at each end, two and two. When the knots are tied, they thus lie between the ends. They are drawn just tightly enough to take up the slack and to cause "buckling" of the tendon at the site of union. Garlock warns that when as a first aid procedure wounds at the junction of fingers and palm have been sutured too tightly without a preliminary debridement, a suppurative tenosynovitis rapidly develops, the flexor tendons slough and the fingers are left permanently crippled unless there is prompt secondary intervention.

After suture of a ruptured tendon of the hand, the member is placed at rest with dressings so arranged as to prevent tension; i.e., in a folded posture for the flexors and a straight position for the extensors. If both are ruptured, a neutral position is effected. It is then kept immobilized for seven to ten days, after which active motion can be instituted.

Tendon Lengthening. Various means have been devised for lengthening a ruptured tendon when it cannot be made to reach its normal site. This is frequently necessary after retraction and healing in a crippling condition have occurred, a secondary tenorrhaphy being done to bridge the gap. In its simplest form, both ends of the tendon are cut horizontally at any desired distance from the end to a point halfway across the tendon. At this point the knife is carried back at right angles toward the end, cutting longitudinally and splitting the tendon almost to the end, leaving just enough of the tendon unsevered to make a sort of hinge. The free side of the split tendon of each end is then rotated 180° on this hinge as its axis until it faces and meets its mate of the other end, to which it is sutured, thus producing a lengthening of the tendon to any extent desired.

Many modifications of this method exist. Another method of lengthening often used is to insert a silk thread to fill up the gap. If the breach is not too long, Nature will soon clothe the silk with fibrous tissue and the tendon will have been reconstituted, often with good function.

Tenodesis, or Implantation. When other methods are not readily available, a severed tendon may be grafted onto a neighboring tendon or even to a bone. Thus, if one of the four tendons of the flexor sublimis or profundus digitorum is too seriously damaged for its ends to unite, its distal end may be attached to one of the neighboring sound tendons of the same muscle, since both have the same innervation. When the attachment is made to a bone, a hole is drilled in the latter to receive it.

Tendon Transplantation. Free grafts of tendons are indicated in cases where owing to excessive loss of substance no other method is applicable. These are usually homoplastic, taken from the Achilles tendon or the thigh; but they may occasionally be heteroplastic, from freshly amputated

[1] Garlock, John H. Injuries of the tendons and nerves of the hand and wrist. Exhibit of drawings at the Ninth Annual Graduate Fortnight, illustrating his treatment. New York Adademy of Medicine (Oct. 19–31) 1936.

limb of another individual, if such happens to be available at the time. Free or tubular grafts from the patient's forearm or abdomen are sometimes useful in finger injuries.

Meyer and Ransohoff[2] have recently been using with good success the celloidin tube method for reconstructing scarred digital tendons resulting from a neglected rupture. They use a two-stage operation:

1. The scarred tendon and its sheath are removed and a celloidin tube implanted in their place to bridge the gap temporarily, until the surrounding tissues adapt themselves to a normal position which the tube imposes.

2. The celloidin tube is then removed and the flexor sublimis of an adjacent finger is lengthened by a free tendon graft to reach the tip of the scarred finger. Each detail of the operation is based on an accurate knowledge of tendon anatomy and physiology and has for its essential principles the retention of the gliding function of the tendon and the restoration of normal physiologic tension to muscle and tendon.

Among ruptures of the larger muscles that the general practitioner meets in his practice, the commonest are those of the quadriceps and the long head of the biceps. In a quadriceps rupture the knee joint capsule also is liable to be ruptured. If such is the case, or if the belly of the muscle is rolled up into a hard ball, operation is imperative; for Nature cannot heal it properly. If it is neglected, there may be union, but not a satisfactory one, as it produces an elongation that will considerably weaken the quadriceps muscle.

After waiting a week or so for the inflammation to subside, a crescent-shaped incision is made on the internal border of the anterior aspect of the knee joint. The hematoma is removed by dissection and the different components of the muscle are identified, of which the rupture may involve all or only some. The ruptured capsule is sutured with No. 1 plain catgut. The ruptured tendon ends are approximated and sutured with absorbable material. In some instances the suture of kangaroo tendon must be made fast to the patella, in which two holes are bored. The knee is immobilized for two weeks in a long Thomas splint elevated at an angle of 20°, at the end of which time passive and active motions are instituted. In some cases, in which the muscle is found rather friable, a flap of fascia from the thigh may have to be inserted into it. As the quadriceps muscle undergoes more rapid atrophy than any other in the body, the restoration of its continuity is of the greatest importance.

When the Achilles tendon is ruptured, it should be put at rest in a position of shortening. Under no conditions should a tight bandage ever be applied. Strapping and rubbing have been known to cause effusion and scar tissue over an extended area. Early surgical repair in complete or extensive tears saves much time and results in better function than attempts with palliative measures.

In ruptures of the head of the biceps, a large hard roll consisting of muscle belly is seen protruding on the anterior aspect of the arm above the elbow, with a furrow above it. The arm is weak but not helpless, since only one-half of the muscle is torn. Through a longitudinal slit, the muscle is reached, the hematoma removed, the frayed ends cut away, and an appropriate suture of chromic catgut placed. On account of the peculiar anatomic disposition of its origin, it may have to be sutured partly to the periosteum of the glenoid fossa and partly to the joint capsule, if the rupture is very close to the acromion attachment. The arm is immobilized for about three weeks in plaster in a slight degree of abduction of the upper arm and in supination of the forearm in maximum flexion. The presence of arthritis deformans is frequently a contributing factor in this type of rupture.

SOME POINTS OF TECHNIQUE

In operating upon ruptured tendons there are a few important rules that should

[2] Mayer, Leo. Ruptured tendons of the hand (Mayer-Ransohoff treatment). Exhibit of drawings at Ninth Annual Graduate Fortnight, illustrating his treatment. New York Academy of Medicine (Oct. 19–31) 1936.

invariably be borne in mind. Briefly stated, these are:

1. Never forget to look for a hematoma or to remove it including all traumatized tissue.

2. Do not suture a tendon under excessive tension; maintain exactly the normal amount of tension to enable the tendon to reach its place without pulling.

3. Do not forget to dissect back widely where tendons are extensively lacerated. This is especially important in ruptures in the hand, wrist and forearm.

4. Be sure that you have done a complete debridement of the skin wound before closure.

5. Take great care to maintain the integrity of the vaginal ligaments of the tendon sheaths.

6. In suturing, always have your alinement correct. This is as important in torn muscles as in broken bones. The line of traction must be mechanically faultless.

7. In making transplantations, do not expose the tendon for one unnecessary second.

8. Never wrap a tendon in gauze.

9. Never grasp its gliding surface with forceps.

10. Never make violent traction upon a tendon.

11. Be sure that the injured tendon is supplied with an abundance of well oxygenated blood.

12. If there is much skin soiling, wait two weeks or more for the skin to heal before you operate. Infection may ruin your results.

SUMMARY

1. Since tendons form the insertion of muscles to their bony attachment, any disturbance of their physiology is linked necessarily with the muscles of which they are a part.

2. Among our most frequent tendon ruptures are those of the hand, the sites of predilection being the flexor of the middle finger in its middle phalanx, the center of the palm, and the extensor of the thumb in its second phalanx.

3. Symptoms and appropriate methods of care and treatment are discussed.

PLASTER-OF-PARIS

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FOR many years plaster-of-Paris has been used as a means of fixation in the treatment of many orthopedic and surgical conditions. For a time, and perhaps still at present, many surgeons hesitate to use plaster-of-Paris dressings because of damage to tissue, which may result in permanent damage and disability to the patient. These difficulties can be avoided, providing a few general principles are observed and providing the physician or surgeon will give the individual case the careful attention, observation and follow-up which it deserves.

Plaster dressings are no more dangerous than other dressings, because plaster does not contract, but if indentations are made in a plaster dressing in the course of its application by the surgeon's or assistant's fingers, it is natural that pressure will result against the skin under the indentation. During the application of the dressing if wrinkles or foreign material are lying against the skin pressure sores are very apt to develop. Care during the application will avoid this complication. Often the use of talcum powder over the skin aids in preserving the skin.

Frequently one observes pressure sores over the heel. This is usually due to the fact that the surgeon allowed the cast to be placed against a hard surface before the plaster encasement had become sufficiently hardened. One of the first symptoms of which the patient complains, in cases of this kind, is a burning sensation in the region of the heel. One should never minimize any complaint which is made by a patient who has had a plaster-of-Paris dressing applied.

The bandages are very easily prepared and they can be kept over a long period of time providing they are kept in tin cans (bread boxes) in a dry place. Plaster bandages which are made from crinoline plus a dental plaster-of-Paris are generally considered to be the best. The crinoline must be not less than thirty-two mesh and the plaster-of-Paris must be a very good grade of quick setting dental plaster. The crinoline is torn in the desired lengths and rolled in bandage forms. Most surgeons prefer a 2 inch bandage two yards long, a 3 inch bandage three yards long, a 4 inch bandage four yards long and so on up to 6 inches. These rolls then have two threads pulled from each side so that the threads will not fray when the bandage is being applied. Tight threads are apt to cause constriction and possibly pressure sores.

To make a satisfactory plaster-of-Paris bandage by hand the dental plaster must be very thoroughly rubbed into the meshes of the crinoline. If this is not carefully done it will be found that the dressing will consist of nothing more than wet crinoline.

Poorly made plaster-of-Paris bandages make it necessary to use more bandages for a dressing and prevent the surgeon from applying a neat, comfortable and satisfactory dressing. There are one or two very satisfactory machines available today for making plaster bandages, but most men who use a great deal of plaster feel that the handmade bandages are the best, providing the same individual always makes the bandages and that he or she give careful thought and time to the preparation and preservation of the plaster-of-Paris bandages. One difficulty which is frequently offered is that the individual who makes the bandages complains that the heel of the hand becomes very sore, which will necessitate a rest period occasionally.

Some men who use a great deal of plaster-of-Paris feel that it is quite neces-

sary to have each bandage wrapped in newspaper or a paper napkin. This is unnecessary because the bandages will keep just as well if they are placed gently and carefully in rows in a tin bread box and put in a dry place.

When the bandages are being used the assistant and the surgeon should avoid dropping any water on the bandages which are not being used. Drops of water on the dry plaster cause hard spots in the bandage which are troublesome and do not lend to the application of a satisfactory dressing.

The bandage should be carefully placed in a pail of clear warm water and allowed to remain there until all the bubbles cease coming from the bandage. This is an indication that the bandage is thoroughly saturated and ready for use. Bandages which are not thoroughly saturated should not be used as they tend to interfere with the application of a smooth dressing. It is best to use a deep pail so that the excess plaster which accumulates will not delay the saturation of the bandages which are being used. When considerable excess plaster is found in the bottom of the pail it is best to change the water or better to have a second pail always available. No salt or other chemical is necessary when one uses a quick setting plaster.

If an assistant or nurse is engaged in saturating the plaster bandages, the bandage is gently squeezed from both ends toward the middle so that the plaster is not squeezed from the bandage. The end of the bandage is then located and started before it is handed to the surgeon. Much time can be saved by this maneuver and this is quite important, particularly if the patient is under an anesthetic.

Training is necessary in the application of a plaster bandage, but because most people have a happy yen to retain their "mud-pie tendencies," plaster work seems to appeal to them. Nothing will develop the ability to apply plaster more readily than the frequent application of dressings. The dressing must be placed on the extremity in such a way that it is smooth and every layer carefully and thoroughly rubbed in. *The bandage must not be pulled tight*, it should simply be rolled around and as it rolls it should be rubbed so that every layer is well smoothed off and the various layers well amalgamated. Indentations and irregularities should be avoided. Reinforcements may be used, but they should also be made of plaster-of-Paris.

Padding under a plaster-of-Paris dressing is used to protect the bony prominences. Some men prefer to use more than others. As one becomes more expert in his ability to use plaster-of-Paris it becomes less necessary to use much padding. The less padding the lighter the encasement and the more attractive the dressing.

Plaster-of-Paris dressings do not need to be heavy in order to afford the immobilization which is intended. Heavy plaster dressings are burdensome and certainly are not attractive. A light, smooth, well fitting plaster case is the work of a real artist.

Plaster-of-Paris bandages are very useful in the office of every physician and surgeon. The general practitioner finds considerable use for plaster-of-Paris in his office particularly in the treatment of fractures. Certainly much better immobilization can be obtained with a plaster splint than with the old-fashioned basswood splint. The application is just as simple and the moulded plaster-of-Paris splint affords much more relief to the patient.

SUMMARY

In this short paper an attempt is made to impress upon the medical profession the value of plaster-of-Paris as a form of immobilization. The article also stresses the fact that good plaster-of-Paris bandages are a definite requisite for satisfactory plaster work. It also stresses the fact that careful, thoughtful application of plaster is necessary in order to avoid complications. Some of the dangers are mentioned and instructions given to avoid these complications. The value of plaster as an adjunct in the office in the care of fractures or other joint conditions is also mentioned. The care and the making of the bandage are carefully described.

USE OF ADHESIVE IN ORTHOPEDIC PRACTICE

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THE use of adhesive in the practice of orthopedic surgery differs in few respects from its use in the general practice of medicine and surgery. A review of the subject as discussed by Krida[1] and Willis,[2] together with a few additions, would seem relevant at this time.

The proper use of adhesive often saves time and expense to both the physician and the patient. It may be applied to act as an external splint to underlying injured tissues, or its sole purpose may be to act as a check or reminder and thereby prevent further damage to an injured member while repair is taking place.

In sprains and strains of the lower extremity, the use of adhesive around the forefoot or applied to the ankle usually results in the immediate rehabilitation of the individual. At the present time when the roentgenogram shows no fracture of the bones of the foot or ankle, the stirrup strapping is applied and immediate weight bearing is prescribed. The old ice bag treatment for twenty-four to forty-eight hours followed by rest in bed for several weeks is eliminated, as well as a prolonged period of physiotherapy. Waterproof adhesive, though it does not adapt itself to the various curves and contours as readily as the older form, allows the individual to continue without interruption their daily or weekly ablutions.

A word of caution seems necessary, even at this age, as to the application of adhesive to an extremity. So many of our confreres insist on encircling an extremity, either to anchor the stirrup strips or to depend on the circular strips as a support.

As swelling is always a complication due either to (1) an injury to the tissues, (2) lack of use and venous stasis, or (3) to the dependent position of the part, it is quite as necessary to either split or bivalve such a dressing as to split or bivalve a cast following its application.

The Buck's extension, which has been used for many years, is being supplanted by skeleton traction. There are many instances in which adhesive traction will continue to be the method of choice because of its ease of applicability and the freedom resulting from its use. There are four points to be kept in mind when applying a Buck's extension to the leg:

1. The spreader should be of the same width as the heel;

2. A small square of gauze should be placed over both malleoli before the adhesive is applied;

3. The strips to anchor the stirrup strapping should encircle the leg obliquely to prevent interfering with the circulation; and

4. No strips should cross behind the Achilles tendon.

Adhesive is used in different ways by various individuals. Some may rely on it to approximate wound edges, treat ulcers and fractures, when another would have to resort to the use of plaster-of-Paris. In supracondylar fractures of the elbow, I have been using an adhesive lacing corset for eleven years (Fig. 1). Two partial cuffs are made depending on the size of the arm and forearm (Fig. 2). After reducing the fracture, a piece of sterile gauze is placed in the flexed elbow and the cuffs are applied. A small piece of tape is used to lace the cuffs together on both inner and outer aspects.

CONCLUSIONS

The method recommends itself for the following reasons:

[1] KRIDA, A. *Am. Jour Surg.*, 6: 430–432, 1929.

[2] PARK, W. W. *Northwest Med. Jour.*, 29: 229–230, 1930.

1. Pressure is distributed generally over the arm and forearm without constricting edges, such as results from the use of a single band of adhesive;

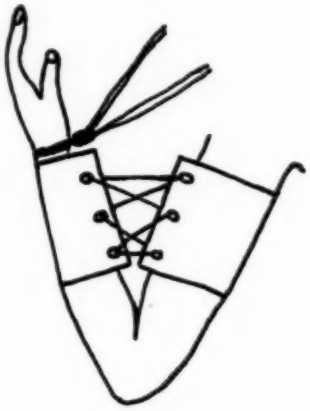

Fig. 1.

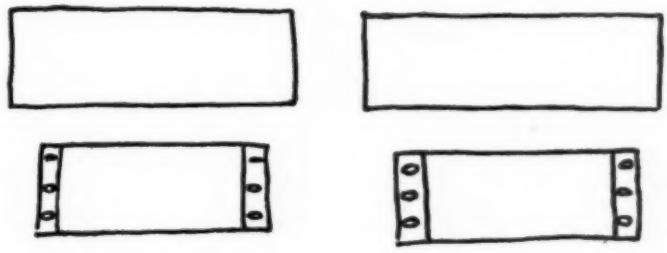

Fig. 2.

Fig. 1. Adhesive lacing corset applied in supracondylar fracture of elbow.
Fig. 2. Two partial cuffs made according to size of the arm and forearm.

2. Full supination is maintained;

3. There is no encircling bandage to disturb the circulation;

4. The radial pulse area is open and its condition may be noted without disturbing the bandage;

5. The test for impending Volkmann's ischemic contracture may be made by hyperextending fingers and hand. This is the first indication of a Volkmann's paralysis and should receive immediate attention by incising the fascia of the forearm;

6. The results of nerve injuries may be observed;

7. Active use of the arm in flexion (touching the fingers to the shoulder) may be instituted at once; and

8. The range of exercise may be increased by loosening the lacings as union progresses without disturbing the bandage.

USE OF UNPADDED PLASTER IN TREATMENT OF FRACTURES*

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PLASTER-of-Paris casts are used in the treatment of fractures to hold the fragments immobile, in apposition and maintain these fragments in the best possible alinement. The immobilization of fractures dates back to prehistoric times.

Magnuson[1] in a recent article has shown that for countless ages the Greeks and Romans as well as the Chinese held their fractures immobile by parchments, woods, resinous bandages, leather splints, hides and wax cloths. During the Renaissance many complicated traction devices were invented for the reduction of fractures and dislocations. Many of these reduction devices were a humane application of what formerly had been a torture stretching mechanicism. Frequently a pulley system was used an illustration of which is the Russell Traction[2] now perhaps one of the best methods of treating a fracture of the femur.

As it is not within the scope of this paper to discuss the methods of reduction of fractures nor their after care, our remarks are confined to a method of immobilization which we feel is superior to that commonly used and one which permits the patient to be more active as well as to shorten his period of convalescence. We make no claim for originality in this paper, but we have used non-padded casts for years and like them. We think the claims of Boehler[3] are not exaggerated, for our patients are up walking and mobile where other cases treated differently are at home with a "sick in bed" psychology.

Plaster-of-Paris bandage was first used for the immobilization of fractures by Mathysen in 1852. Its introduction was enthusiastically received. Fractures had previously been immobilized by huge thick casts that required assistance to move. We can imagine the results which must have followed these heavy casts that stayed on too long or too short a time, and which had been applied too loosely or tightly. Many limbs must have been sacrificed. We know that casts became so general that frequently it was thought that a reduction was not necessary but that the cast was the all important feature of the treatment. Accumulated experience and time soon proved otherwise and the result has been the evolution of the reduction of fractures followed by the application of well padded casts as are now in general use. However, through this period some adventurers have found that plaster splints applied on the bare skin have been efficacious, but because of the constant fear of an ischemic myositis its use has been almost nil.

The technique of applying an unpadded cast[4] is simple: a 4 or 6 inch roll of plaster which has been prepared in the office or purchased and which has had the edges notched or raveled is immersed in tap water until all bubbling ceases. The plaster is then grasped in both hands, squeezed slightly together and removed from the water. The desired length of the splint is now layed out on a smooth flat table or board. The plaster bandage is then reversed on itself to the point of the beginning and this is repeated until the splint has eight to ten thicknesses. This forms a plaster splint. The splint must have no wrinkles and must be soppy. A 3 inch piece of quilting is now encircled around the leg just below the knee and is held in place by adhesive (Fig. 1). The splint is placed so that one end rests on the quilting posteriorly. The splint now follows down the posterior surface of the leg, over the heel and beyond the toes (Fig. 2). As the splint rounds the

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heel it will form a fold, which is controlled by cutting the protruding flaps transversely and placing the proximal segments against the side of the heel, the remaining flap is then molded over the proximal one. Griswold[5] has shown that if the splint is sufficiently soppy and has no wrinkles it will lay smoothly on the leg. The circular bandage is now begun at the middle of the leg and continued over the heel and foot to the base of the dorsal surface of the toes and no further. It is important to let the bandage unroll and never draw it tight. It is equally important to have no wrinkles on the skin as they will later cause pressure ridges. If wrinkles try to form in the circular bandage let them be placed posteriorly on the plaster splint. The posterior splint protrudes beyond the toes and will allow support for the toes as well as prevent bumps and annoyances of the weight of bed covering (Figs. 3 and 4). Swelling within the cast can be largely prevented by elevation of the limb, either on a Thomas Splint, on pillows, or by suspension. The toes should be closely watched for the first forty-eight hours, if they show signs of circulatory constriction, that is cynosis, coldness, loss of sensation, or motion, the cast should be immediately split from end to end. This permits edema to occur without circulatory construction and at the same time allows the bony fragments to be held in their position of reduction. Caution as to care in edema cannot be too fully emphasized.

Fig. 1. Quilting applied to leg.

Fig. 2. Posterior splint applied.

There is no preparation of the skin before the cast is applied. The leg should not be shaved nor greased because this defeats part of the purpose of the cast which is to adhere firmly to the skin and to closely mold over all bony prominences.

This type of cast is efficient on fractures of the foot and ankle. If the injury is above the ankle and not above the knee the cast

Fig. 3. Splint encased by cast and heel incorporated.

should be made to extend from the groin to the toes. This is accomplished by cutting a piece of quilting 6 by 24 inches, rolling it tightly lengthwise and then wrapping it with a 2 inch muslin bandage. This is now placed in exactly the same position that the ring of the Thomas walking caliper would occupy, and held there with a sling by an assistant. A long posterior plaster splint is made as previously described and then applied to the bare skin posteriorly from the quilting roll to beyond the toes. An anterior splint may be likewise placed running to the base of the toes only, and the whole wrapped with circular unwrinkled plaster. The assistant always holds the cast with the palm of the hand or fingers, but never with the fingers indenting. The cast should never be tight. It must be constantly rubbed to expel air pockets. This makes the cast strong and hard, but light and thin. Five rolls of 6 inch plaster will make the entire leg cast. If the cast is made for a healing femur or pelvis it is applied as follows; a pelvic stockinette is first applied. Triangle pads of quilting or felt are placed over the sacrum, buttocks,

Fig. 4. Whole leg cast.

trochanters and anterior-superior spine areas and are held in place by figure of eight muslin bandages. The pelvic cast is then applied in the usual manner and extends to the costal margin. This being completed the leg cast previously described is applied and the two incorporated by plaster splints and circular casts (Fig. 5). The place of union must be well rubbed and made strong.

The patient can now walk. By incorporating certain appliances on the foot, weight may be borne on the afflicted limb without pain and with benefit (Fig. 6). The heels are "U" strips of iron ¾ by ⅛ by 24 inches long. The bottom of the "U" admits one finger between the plaster and the iron heel. It should be applied the day following the application of the leg cast and must be in the weight-bearing axis of the tibia. A piece of large tubing or hose 4 inches long

over the "U" prevents slipping as well as noise and floor scratching. There have been many attempts to improve the iron "U"

Fig. 5. Cast including pelvis.

by many complicated gadgets none of which seem to be as satisfactory as the plain Boehler "U" which is our choice. Another type of heel[6] is made by incorporating a rubber sponge in the boot heel, the disadvantage we have found with this is that first the cast being in contact with the ground may become damp and soft, which results in unequal pressure within the heel of the cast and discomfort to the patient. A third type of heel can be made by incorporating in the cast a bedroom slipper sole but this has the same disadvantage as the rubber sponge. A fourth heel is a wooden sole 3 by 6 inches, tapering in thickness from ¼ inch at the toes to ¾ inch at the heel. This is incorporated in the sole of the boot by one plaster roll. It has been unsatisfactory, because the long flat sole limits the anterior-posterior roll in walking. The foot must be "toed out" to permit walking. Only one of our patients liked this heel.

Unpadded plaster is not confined in its scope to the lower extremity. No other or form of attempted immobilization splint holds the forearm half so well. We reduce a Colles's fracture by fixing the elbow in a belt

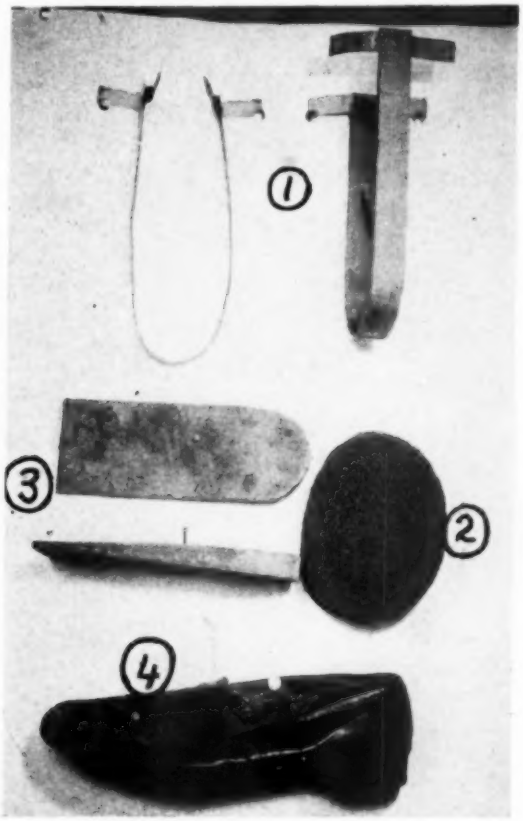

Fig. 6. Types of heels: (1) Boehler heel; (2) rubber sponge; (3) wedge board; (4) old bedroom slipper.

to a hook in the wall. An assistant makes ten minutes traction on the thumb and

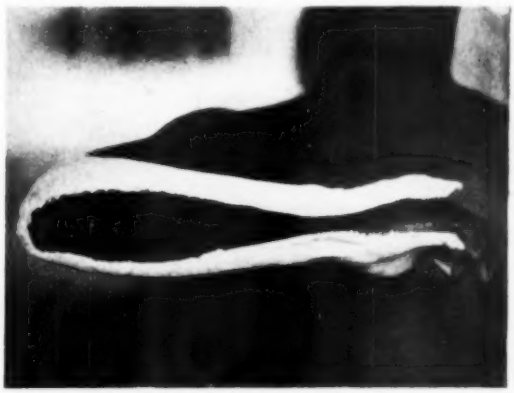

Fig. 7. Forearm splint.

index finger and disregards the remainder of the hand. Manipulation is often unnecessary for traction frequently does the reduc-

ing. If the impaction is not reduced a slight manipulation while under this traction reduces the fracture. An unpadded splint

Fig. 8. Whole arm splint.

is now placed dorsally from 3 inches distal to the elbow to the metacarpophalangeal joint, also an anterior splint is applied. These may be wrapped by muslin or by plaster. The splint must exactly fit the forearm (Fig. 7) and the traction continued until the splints harden. If the splints are encircled with plaster a split is made on one side between splints, by this means the forearm is adequately immobilized and finger exercises are begun at once.

Most clean wounds do not need redressing, and do better if left alone. We frequently leave a sutured wound untouched for six or eight weeks until the cast is removed. Dressings over these wounds should not be thick, they should be held in place by the plaster splint which will not infect them, but which will inhibit infection for it has been shown by Griswold that due to its alkalinity plaster is bacteriostatic to the usual pathogenic organisms, so an infection through a thin dressing will not occur.

If the fracture has been compounded, and edema or infection makes it necessary to cut a window, pressure should be applied over this window to prevent edema. This is adequately accomplished by a sterile sea or rubber sponge.

Another excellent arm cast is one which is made from a splint which extends dorsally from the knuckles over the dorsal surface of the forearm, around the elbow which is flexed to right angles and padded by three layers of silence cloth across the volar forearm to the second phalangeal joint. This is the so-called sugar tong splint described by Jewett.[7] The pronation-supination is governed by the location of the fracture and the hand placed in slightly dorsal flexion, the whole is wrapped by 3 inch muslin bandage which makes an excellent immobilization (Fig. 8). For upper arm fixation a "U" plaster splint is used which extends from the padded axilla over a padded elbow and thence up the lateral surface of the arm above the shoulder, the whole being wrapped in muslin and carried in a triangle sling (Figs. 9 and 10). This will not immobilize fractures involving the shoulder.

The advantages of non-padded plaster are many. The skin remains healthy because the sweat and excretory oils of the skin are absorbed by the plaster and cannot irritate the skin. Because of better immobilization the adjacent joints can be exercised thereby increasing circulation, preventing static edema and promoting healing. Our walking casts are leaving freely mobile joints immediately on removal which is something unheard of in a padded cast. Circulation of the legs remains good, because as the patient puts weight on the heel the muscles contract and act as a pump to the leg circulation. In walking the pump action empties and fills with each step. The bones are immobile

because of the molded cast. Sores never develop under the cast as is so frequently seen in padded casts with wadded cotton and an oily irritated skin. The cast is removed easily and painlessly. Boehler has shown that the arm and leg hair desquamates every four to five weeks, so there is no hair pulling. The cast is split with a crowbill plaster knife or thin bladed cast cutter. The cutting is made very easy by wetting the plaster for twenty minutes at which time it cuts like thin cardboard.

Fig. 9. Upper arm splint.

Fig. 10. Upper arm splint wrapped with muslin bandage.

CONCLUSIONS

1. Unpadded plaster casts can be safely applied to the skin to secure better immobilization of extremities.

2. These casts are not difficult to apply and by their use a stronger but lighter cast is used.

3. Patients are mobile which adds to their comfort as well as hastens recovery.

4. This cast does not irritate the skin but absorbs the skin's excretory products and has an inhibiting action upon the growth of pyogenic bacteria.

REFERENCES

1. Magnuson, P. B. *Surg. Gynec. and Obst.*, 62: 276–286 (Feb.) 1936.
2. Russel, R. H. Fractures of the femur. *Brit. Jour. Surg.*, 9: 491, 1923–1924.
3. Boehler, Lorenz. Treatment of Fractures, 4th English Edition translated by Ernest W. Hey Groves, Baltimore, Wm. Wood & Co., 1935.
4. Schnek, Fritz. Vienna, Wilhelm Maudrich, 1932.
5. Griswold, R. A. *Am. Jour. Surg.*, 32: 247–257 (May) 1936.
6. Rechtman, A. M. and Subin, H. *Am. Jour. Surg.*, 29: 149–151 (July) 1935.
7. Jewett, E. L. *Am. Jour. Surg.*, 26: 336–339 (Nov.) 1934.

MINOR SURGERY OF SPINE

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FOR the purposes of this discussion, minor surgery of the spine is limited to those procedures which do not require especial technical skill.

Surgery of the spinal column presents peculiar difficulties. The spine is composed of twenty-nine movable segments and five fused segments. Each segment must carry the weight of the portion of the body above. The block-like segments of this weight-bearing mechanism are held in proper alinement by the coordinated pull of the powerful muscles which attach to all the segments. It must be borne in mind that the vertebral column consists of two parts, two vertical pillars of multiple segments; an anterior column composed of the vertebral bodies which is distinctly weight-bearing in function, and a posterior column composed of the neural arches whose function is multiple, i.e., protection for the cord and attachment for the spinal muscles and ligaments.[1] Except in cases of intrinsic spinal cord disease, the function of the spinal cord depends upon the maintenance of an adequate amount of space within the neural canal. Any abnormal change in the relationship of the movable vertebral segments, whether due to loss of coordination of the controlling musculature, or disease, fracture or congenital deformity of the vertebras usually results in impaired spinal cord function or impaired function of the spinal nerves which leave the neural canal through the intervertebral foramina. The entire spinal column, with the exception of the tips of the spinous processes, is embedded in heavy musculature. It follows that because of the complicated structure and function of the spine along with its deep location and its proximity to vital nerve tissue, surgical approach is technically difficult and minor surgical procedures are limited to (1) the introduction of needles into the subarachnoid and epidural spaces for diagnostic and therapeutic purposes and (2) the correction of uncomplicated fractures and deformities by manipulation and apparatus.

SUBARACHNOID PUNCTURE

The spinal subarachnoid space is a potential sac surrounding the spinal cord, the size of which is determined by the volume of cerebrospinal fluid present. Above, this sac is continuous with the cranial subarachnoid space; below, it ends at the level of the lower border of the second sacral vertebra. The spinal subarachnoid space ends, therefore, at a considerably lower point than the spinal cord which terminates at the upper border of the second lumbar vertebra. To avoid puncturing the spinal cord, tapping of the subarachnoid space is done at a point below the termination of the spinal cord, in the interspace between the spinous processes of the third and fourth lumbar vertebras. This interspace lies along the line connecting the crests of the ilii.

The position of the patient during the introduction of the needle is of extreme importance. The patient is placed on his side at the edge of the bed. The knees and head are drawn together so as to force the spine into hyperflexion, thereby widening the intervertebral spaces posteriorly. The lumbar region of the back must be exactly parallel to the edge of the bed and the transverse diameter of the back vertical. The needle may also be introduced with the patient sitting upright and bending forward to force the spine into acute flexion.

Having carefully placed the patient, an area a few inches in diameter, centering on the spine at the level of the crests of the

ilii, is painted with tincture of iodine and draped with sterile towels. The surgeon scrubs his hands and puts on rubber gloves. After palpating the depression between the spines of the third and fourth lumbar vertebras, a small weal is made in the skin with 1 per cent novocaine solution. A short bevel spinal puncture needle is then inserted exactly in the midline, halfway between the spines of the third and fourth lumbar vertebras. The needle is directed straight in at right angles to the skin in both longitudinal and transverse planes. In some cases the needle may strike the bony surface of the vertebra and it will be necessary to withdraw it part of the way and redirect the needle slightly upward toward the head. At a depth of about two inches the point of the needle may be felt to pass between the two vertebras. As the dura is perforated a peculiar sensation of release of resistance will be appreciated. The stylet of the needle is withdrawn and if the subarachnoid space has been entered, spinal fluid will drip from the needle.

In cases of scoliosis with rotation of the vertebras, it is necessary to direct the point of the needle laterally, away from the midline, toward the apex of the curve, the amount of lateral deviation of the needle depending upon the degree of spinal deformity.

Puncture of the Subarachnoid Space at the Cisterna Magna. Gilman and Kempt[2] describe an excellent technique for cisternal puncture.

A needle of larger gauge (16) that is not very flexible and has a small hilt is preferred, because it can be directed more accurately, a freer flow is insured, and the weight of the hilt will have less tendency to drag on the needle during the actual process of drainage. The needle should have a short, sharp bevel in order to allow entrance of the point without danger of the tip striking the medulla.

The patient is placed on the side, with the head on a pillow or pad of sufficient thickness to keep the head and the cervical and thoracic vertebras in the same horizontal plane. The shoulders should be kept vertical and the head slightly flexed; however, patients with opisthotonos are allowed to maintain the position of their heads but otherwise placed in the foregoing position. The position of the epistropheus is noted and the finger is placed in the suboccipital triangle (felt between the occiput and epistropheus as the depression in which the finger cannot be moved horizontally or vertically without leaving it). The position of the posterior border of the mastoid and its distance from the suboccipital triangle is estimated. This is the approximate distance the needle will have to be inserted in order to reach the cisterna magna.

Iodine is applied over the suboccipital triangle which has previously been clipped and shaved. A local anesthetic may first be instilled, although, when the puncture is to be repeated over a series of days, infiltration of the tissues frequently is not desirable because of the tendency to edema. With the patient's head facing straight forward so that there is no twist of the neck to the right or left, the needle, with the bevel directed caudally so as to avoid skiving tissues from the occiput into the lumen is inserted into the skin in the exact midline just at the upper border of the first spinous process. If the needle is started at a higher level one is apt to reach the cisterna with the needle pointed at the bridge of the nose, because the tissues and bony configuration will not prevent tilting. This direction gives 1 cm. less space for safety than if the needle is directed toward the normal hair line. If the needle is started in the exact midline at this point and directed at a point in the exact midline, at the usual place for the hairline, one can in many cases slowly and steadily carry the needle into the cisterna magna without changing its course. However, the needle usually strikes the base of the occiput first. In either event, when the needle has been passed through the skin and outer ligaments, the stylet is removed. One then gradually pushes the needle toward the cisterna, never allowing the tip to point below the eyebrows and attempting to keep it pointed as nearly as possible toward the hairline.

In order to insure a steady and gradual movement of the needle and to avert its going too far when it passes through the dura, it is best to hold the needle with both index fingers and thumbs, keeping the remaining fingers against the patient's neck and head for sup-

port. This assures a steady even pressure on the needle and prevents one from penetrating too deeply when the needle passes through the atlanto-occipital membrane. By this method the feel of passing through the dura (so essential when the stylet is left in) becomes less important, although it is still well to recognize it. As soon as the tip of the needle passes through the dura spinal fluid appears and with the larger needles even very purulent fluid appears at once.

The required depth is about 4 or 4.5 cm. Sometimes as low as 3 and as high as 6 cm.; however, frequently an unusually long occiput or an unusual muscular development makes the distance 7 cm. or even 8 cm.

EPIDURAL PUNCTURE

The epidural space extends the entire length of the spiral canal from the foramen magnum to the coccyx, beginning above where the thick cranial dura splits at the foramen magnum into its two functionally different layers. The external layer lines the spinal canal as the periosteum and thick fibrous covering of the ligaments of the spine. The inner layer becomes the true spinal dura and covers the cord as a sac. Between these two layers is a definite space, the epidural space, which contains semiliquid fat and a venous plexus. The true dura is continued as a cuff over the spinal nerves as they pass through the epidural space until just after the nerves leave the intervertebral foramina. For this reason[3] it is impossible for anesthetic solutions to block the spinal nerves within the epidural space. What actually happens is that a solution injected into the epidural space infiltrates the semiliquid fat surrounding the dura and spreads both superiorly and inferiorly. At each intervertebral foramen, some of the solution leaves the space along the perineural lymphatics surrounding the nerve trunks and anesthetizes these trunks producing in this manner a massive nerve trunk block comparable to a perfect paravertebral block.

When the spine is in acute flexion, there is negative pressure in the epidural space.[4] Odom[3] has devised a simple manometer to use this fact as the means of locating the space. The short bevel lumbar puncture needle is introduced in the same place and in the same manner as for subarachnoid puncture. As soon as the manometer indicates negative pressure, 35 to 50 c.c., depending on the height of anesthesia desired, of 2 per cent novocaine are injected into the epidural space. A period of fifteen or twenty minutes must be allowed to elapse for the diffusion of the anesthetic solution before operating.

Caudal Epidural Puncture. Epidural anesthesia for caudal block is performed by depositing the anesthetic solution through the sacral hiatus into the caudal canal. The patient is placed in a prone position and the sacral area prepared surgically and draped with sterile towels. The caudal needle should enter the skin through the triangular shaped depressed area bounded by the two sacral cornua and the protuberance in the median line at the distal end of the sacrum. After a wheal has been raised[5] with 1 per cent procaine, the skin over the sacrum is immobilized with the left hand and the point of the needle, already attached to the syringe, is passed into the sacral hiatus with the bevel of the needle against the bone. The anesthetist rests the hand which holds the syringe on the patient's buttock so that, should the patient move, the anesthetist's hand will be raised and the needle will follow the hand rather than the hand following the needle and probably break the needle. The first part of the procedure is performed with a short needle. After the short needle has been introduced into the caudal canal and after 2 or 3 c.c. of a 1 per cent solution of procaine have been injected, the needle is withdrawn and another needle, with its stylet in place, is introduced. This needle must be so inserted that its bevel will be on the rough surface of the bone if it is to be advanced easily into the caudal canal. Its point should be inserted no farther cephalad than a line between the second sacral foramina. Higher insertion of the needle may result in subdural injection, for

the tip of the dural sac may be pierced by the caudal needle. If the ordinary amount of solution, 30 c.c., is injected into the caudal canal, thirty minutes will be required to produce anesthesia suitable for most urological, gynecological and proctological procedures.

TREATMENT OF FRACTURES AND DISLOCATIONS WITHOUT NEUROLOGICAL COMPLICATIONS

Fractures and dislocations of the spine with neurological complications are major surgical problems and do not come within the scope of this paper. Compression fractures of the bodies of the vertebras are difficult to reduce. They usually produce a narrowing of the anterior border of one or more vertebral bodies in the dorsolumbar region. If they can be treated within twenty-four hours after the injury, most of the wedging of the body can usually be overcome by careful manipulation under general anesthesia. The patient lies prone on the canvas sling of the Albee table or is placed between two tables in such a way that the pelvic and pectoral girdles are supported, and the trunk sags anteriorly. This forces the spine into hyperextension and reduces the deformity of the vertebral body. A plaster-of-Paris body cast is applied over a liberal amount of sheet wadding and moulded to maintain the hyperextension of the spine. The patient remains in bed for eight weeks and wears the body cast for twelve weeks. If roentgenograms show evidence of solid union, all support may then be discarded. Usually it is necessary to apply a Taylor spinal brace for another few months.

If the patient is first seen several days after the injury it is usually impossible to reduce the deformity by manipulation and the patient is put to bed on a Bradford frame which is bent in such a way as to force the spine into hyperextension. A body cast is applied after eight weeks, which is moulded to maintain the hyperextension of the spine. The future treatment is the same as that of the manipulated cases.

Fractures of the transverse and spinous processes do not present difficulties. Union rarely occurs in the transverse processes. A body cast is usually applied for a few weeks which is removed as soon as the patient is able to move about without pain or spasm of the back muscles.

Patients with fractures of the lamina and pedicles are placed in bed for a period of eight to ten weeks, after which a body cast or brace is applied and they are permitted to get about. The amount of activity these patients are allowed depends upon the evidence of repair of the fracture as seen in the *x*-ray pictures.

Fractures of the coccyx or sacrum seldom require more than a few weeks rest in bed. Occasionally a fractured coccyx must be excised.

Fracture of the cervical spine without neurological involvement requires rest in bed with traction applied to the chin and occiput by means of a Sayre halter. If the head of the bed is raised on blocks, so that the patient's body weight furnishes counter-traction, this apparatus gives satisfactory immobilization to the upper spine. In many cases it is possible to reduce a dislocation of the cervical spine (without neurological complications) by the same method. The patient remains in bed until all muscle spasm is relaxed and satisfactory evidence of repair can be seen on the *x*-ray pictures. After this, a brace or plaster-of-Paris body cast with an extension which fixes the chin, occiput and head is applied. The apparatus remains on until the roentgenograms show complete healing of the bone or, in the case of a dislocation of the cervical spine, until sufficient time has elapsed to permit firm healing of the ligaments, usually about eight to twelve weeks.

CORRECTION OF DEFORMITIES

The treatment of scoliosis, rotary-lateral deviation of the spine, varies with the age of the patient and the severity of the deformity. Mild degrees of lateral deviation at any age are best treated with exercise. Cases which become worse during this

treatment, especially if the patient is young and will continue to grow for many years, should have the principal curve fused. Before any surgery is done on these patients, the deformity should be corrected as much as possible. The patient is suspended from an overhead support with the Sayre halter. He is raised by this head suspension until only his toes touch the floor. Usually a marked improvement in the deformity results from this stretching. The patient then grasps the overhead support with the hand on the side of the concavity of the upper curve. This produces a further straightening of the spine. A body cast is now applied, which fixes the pelvic and pectoral girdles and includes the upper half of the elevated arm. When the cast is dry it is cut around the body at the level of the apex of the principal spinal curve. On the side of the concavity a turnbuckle is incorporated in the plaster cast at the anterior axillary line and another turnbuckle incorporated at the posterior axillary line. The patient is put to bed and the turnbuckles are gradually opened. In this way the upper and lower portions of the cast are separated on the side of the concavity and the spinal curve is straightened. The maximum correction is usually secured in about two weeks after which the spine is fused through a window in the cast, according to the method of Albee.

It is unsafe to use these methods for the correction of deformities resulting from tuberculosis of the spine. These patients are usually fused without correction as soon as the diagnosis can be made.

The inclusion of the treatment of uncomplicated fractures and deformities of the spine in a paper devoted to a discussion of minor surgery might well be questioned. Strictly speaking, the complicated anatomical and physiological peculiarities of the spine serve to limit minor surgical procedures to the introduction of needles into the subarachnoid and epidural spaces for diagnostic and therapeutic purposes. However, it is felt that the increasing frequency of serious back injuries makes it imperative that the technique of treating uncomplicated fractures and deformities of the spine should be universally understood. For this reason it seemed desirable to add a short summary of the accepted manipulative methods of treatment of these conditions.

SUMMARY

Minor surgical procedures of the spine are limited to the introduction of needles into the subarachnoid and epidural spaces and the treatment of uncomplicated fractures and deformities. The technique of lumbar and cisternal subarachnoid puncture and lumbar and caudal epidural puncture is given in detail. The technique of treating uncomplicated deformities and fractures of the spine by manipulation, traction and casts is outlined.

REFERENCES

1. Albee, F. H. Orthopedic and Reconstruction Surgery. Philadelphia, W. B. Saunders Co., 1921, p. 396.
2. Gilman, L. H. and Kempt, G. F. Puncture of the cisterna magna. *Arch. Neurol. and Psychiat.*, 30: 1282–1286, 1933.
3. Odom, C. B. Epidural anesthesia. *Am. Jour. Surg.*, 34: 547–558 (Dec.), 1936.
4. Heldt, T. J., and Moloney, J. C. Negative pressure in the epidural space. *Am. Jour. Med. Sc.*, 175: 371–376, 1928.
5. Lundy, J. S. and Tuohy, E. B. Reginal anesthesia. *Am. Jour. Surg.*, 34: 511–518 (Dec.) 1936.

FRACTURES OF COCCYX AND COCCYGODYNIA

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THE coccyx is usually formed of four rudimentary vertebras, the number may be increased to five or diminished to three.[1] Its contour is normally the continuation of the curve of the lower sacrum. The first segment resembles the last sacral vertebra with large rudimentary articular processes called cornua. The cornua project upward to articulate or approximate the cornua of the sacrum thus completing the foramen for the exit of the posterior division of the fifth sacral nerve. The articulation between the sacrum and coccyx is homologous with the intervertebral joints, with interposed fibrocartilage, in some instances the coccyx is freely movable on the sacrum and a synovial membrane is present. Such mobility is notably present during pregnancy.

The remaining segments are separated likewise by discs of fibrocartilage. In the adult male all the pieces become ossified together at a comparatively early period. At a more advanced age the coccyx often fuses with the sacrum, this is especially true in females.

Normally there are very limited movements forward and backward between the sacrum and the coccyx, and between the segments of the latter.

The coccyx gives attachment to the levator ani and coccygei muscles which together form a muscular diaphragm for support of the pelvic viscera. Posteriorally the lateral surfaces give rise to the inferior fibers of the gluteus maximus, and the sphincter ani externus takes its origin from the tip.

The anterior division of the fifth sacral nerve enters the pelvis between the sacrum and the coccyx, while that of the coccygeal nerve curves forward below the rudimentary transverse process of the first segment.

The pudendal plexus is not sharply demarcated from the sacral plexus. It is usually formed by branches from the anterior divisions of the second and third sacral nerves, all of the anterior divisions of the fourth and fifth sacral, and the coccygeal nerves. Branches are distributed to the coccygeus, levator ani, sphincter ani externus, the muscles of the urogenital region, to the external genitalia, bladder, rectum and vagina; to the integument about the anus, between the anus and the coccyx, to the scrotum and labium majus. Communication is established with the perineal branch of the femoral cutaneus and the pelvic plexuses of the sympathetic.

The posterior divisions of the lower two sacral and coccygeal nerves unite in a loop formation to supply the skin over the coccyx.

We have then an anatomical foundation whose make up allows of various pathological possibilities, in the production of symptoms referable to the coccygeal region.

To injury from locally directed external forces little protection is offered by the overlying soft parts. From internal forces, injury is inevitable under certain conditions of malposition or fixed deformity, either to the coccyx or to the adjacent structures entering into the production of such forces.

Contusion, strain, sprain, fracture displacement, and irritative phenomena of nerve elements are the common resultant possibilities of trauma.

Morbid processes to which the component parts may be subject, other than trauma induced, make up a second group

of possibilities and third, a group of symptom complexuses not arising in the coccyx, but referred to it by reason of the complex nerve environment.

FRACTURES

Fractures of the coccyx compared to many other fractures are not common, but injuries to the tip of the spine do occur sufficiently often so that the average practitioner on more than one occasion is confronted with them and their problems for treatment.

Dislocations and displacements are included in this discussion as of equal importance with fracture. Lewin[2] has stressed dislocation as the most important of these clinical disturbances.

It is interesting to cite as a classical description the report of a case by Jobi Meekren[3] published in 1682. The patient, a woman, sat down suddenly on the closed seat of a toilet. Because of pain she could neither stand nor walk and was carried to bed. On the second day her pain became worse, Meekren was then called in consultation with her ordinary medical attendant. They suspected the trouble but she would not allow herself to be touched. During the following night her suffering became intolerable and the medical advisors were summoned early in the morning. Reduction of a dislocated coccyx was accomplished per rectum and she was instantly relieved of her symptoms.

Injury by external forces are usually direct in nature and of considerable violence, such as sitting forcibly on small or narrow objects, such as a child's block; kicks or blows received upon the tip of the spine; falls upon the buttocks, in the latter instance males are probably less susceptible to such trauma because of closer approximation of tuberosities of the ischia. The coccyx is driven forward in such instances and if the force is sufficient, displacement or fracture result. Fracture is more likely in those of advanced age.

It is conceivable that falls upon the contracted gluteal muscles, might result in injury by muscular pull upon the coccyx as well as by direct violence. Cyriax[4] has reported a case in an individual who made a sudden effort to save himself from falling. He also calls attention to the importance of minor displacements in coccygodynia.

Injury by Internal Forces. Pressure against the coccyx from within may be the cause of damage to this structure. Pressure of the descending head during labor may result in fracture or dislocation. McCusker[5] comments on these injuries by saying they most often occur in patients with a history of previous injury to the tip of the spine, and that in healing the mobility was lost or that ankylosis occurred in a forward displaced attitude. Vermillion[6] reports 2 such cases of fracture, neither of whom complained of very much pain and the only treatment needed was the rest in bed incident to the confinement. He believes the severity of the symptoms does not depend upon the severity of the injury.

Jolly[7] reports a case of fracture dislocation in a young primipara. It was reduced following a forceps delivery with relief of the symptoms. Nine days later the lower segment of the coccyx was passed from the rectum. No further difficulty was experienced by the patient.

Gant[8] speaks of a case in which anterior displacement and ankylosis of the coccyx required excision before delivery could be effected. He also cites as possible causes of such injuries evacuation of enormous impacted fecal tumors or expulsion from the rectum of foreign bodies.

TREATMENT

In cases where displacement or fracture exists, and whether the former or the latter, is probably more dependent upon the anatomical age of the coccyx, than upon the type of trauma received, the findings of deformity, preternatural mobility, and possibly crepitus will be present. Immediate reduction is ordinarily easy and is best carried out by grasping the coccyx between the fore finger inserted in the rectum and the thumb over the posterior

surface. Anesthesia may be necessary. Splintage is practically impossible to apply with any effectiveness. In some cases maintenance of the reduction is difficult. Bed rest is necessary, four weeks being sufficient in the average case. The possibility of the fracture being compounded internally should be borne in mind. Badly fractured and displaced cases are best treated by excision. Persistent pain may be the aftermath, particularly in those cases where bony repair fails to take place, or where marked deformity obtains. In this class of case extirpation is unquestionably indicated. According to Da Costa[9] coccygodynia is seldom the result of fracture. The treatment of the less severe injuries will be discussed in the second part of this paper.

COCCYGODYNIA

Coccygodynia means literally pain in the coccyx. It is characteristically a paroxysmal aching or stabbing pain occurring spontaneously, and aggravated by any movement which brings into action the muscles attached to the coccyx, such as walking, sitting down or getting up from a chair, defecation and micturition.

Nott[10] was the first to describe the condition, when in 1844 he reported a case of neuralgia of the coccyx, requiring extirpation after all the articles in the materia medica had been exhausted. It is interesting to note that at operation he found the last segment of the coccyx to be carious and thinned out to a mere shell. Simpson[11] was the first to apply the term coccygodynia. In the first publication of his lectures he used the term coccyodynia.[12]

The condition was conceived originally to occur only in women, and was included in the nomenclature of Barnes[13] in his "Diseases of Women" in 1878. Jenks[14] stressed the frequency in women and thus its relationship to pelvic disorders, especially as a result of trauma to which the pelves of women alone are liable. He speaks of the analogy between coccygodynia, fissure of the anus, and vaginismus, in the latter two instances, irritation in the region of the muscle causes painful contraction and he was convinced that in some cases of coccygodynia, the pain was caused in the same way.

The intervening and more recent text descriptions comment on the predominance in females, to which, in many instances have been added the adjectives neurotic or neurasthenic. Burnett[15] reviewed this descriptive attitude, but believe it to be grossly overrated. One must not lose sight however, of the possibility of this region being the outlet for manifestations of a functional disturbance. In coccygodynia a history of injury is the rule, rather than the exception, so that it becomes quite necessary to investigate such a history, in that proper evaluation of the trauma can be made on a physical basis. It is in this type of case that operation and removal of the coccyx has failed to cure the coccygodynia, and thus has rightfully placed a question mark after the indiscriminate application of this treatment. Hamill[16] reported such a case. He compares the pain to that of vaginismus, and believed that understanding not surgery was the best therapeutic approach.

Drueck[17] stated coccygodynia was most apt to occur in women with a history of functional nervous disease, and believed the muscle spasm comparable to vaginismus, and was the result of a mental reflex rather than from real hyperesthesia of the parts. He advised prolonged applications of heat and attention to the mental attitude and emotional status.

We have mentioned before, the possibility of coccygeal symptoms as part of a symptom complex of referred pain. This consideration is an extremely important one in coccygodynia. Kleckner[18] has suggested the name pseudo-coccygodynia as more appropriate to this type of case and advised thorough investigation for anorectal pathology. He also cited utero-adnexal disease in women and pathology of the prostate seminal vesicals and urethra in men as other possibilities. Gant[8] has men-

tioned excruciating pain from ulceration of the rectum, resulting from pressure of the gut against the tip of a malformed and forward displaced coccyx. Perforation as well as ulceration may result.

Disease of the coccyx itself, must be borne in mind, particularly tuberculosis. David[19] reported 2 cases and collected 25 others from the literature. His conclusions were that trauma played no significant role, generalized tuberculosis was conspicuously absent. The onset was insidious. Difficulty was experienced in locomotion but pain with defecation was absent. Sinuses were apt to form through the overlying skin less often into the rectum. Treatment by excision gave a good prognosis.

The author has removed the coccyx in 2 cases, in which, while there was no evidence of an infectious process, there was marked atrophy and softening of the bone structure. They were both in middle aged persons, one male and one female. The onset of symptoms in each instance followed real trauma. Both had received prolonged conservative treatment without profit. Both cases were cured by excision. One is inclined to wonder whether there may occur in the coccyx in certain cases a condition akin to traumatic osteoporosis.

In the initial stage of tabes dorsalis, rectal crises may present the symptom picture of coccygodynia.

TREATMENT

The first consideration is the proper evaluation from a careful history and thorough examination, which includes good *x*-ray pictures of the sacrococcygeal region, the existence or non-existence of any factor or factors which might be expected to produce such a symptom picture.

The indications for treatment in cases of disease, and significant deformities of the coccyx have received comment. That proper attention to, and correction of, abnormalities existing in adjacent or related structures has been discussed. That recognition of coccygodynia as a manifestation of functional nervous disease, has been stressed as important, so that therapy may be applied to both ends of the spine in proper proportions.

We have left then to consider, a group of cases in which the disturbance resides in the coccyx itself and the treatment therefore is to be directed locally. These cases constitute the largest group, and they for the most part have symptoms resulting from trauma. The local findings are tenderness and increased pain on pressure or attempted movements of the coccyx. There is no significant deformity or evidence of disease.

In the more acute instances restriction of the activities which aggravate the pain must be enforced even to the point of rest in bed. This is of particular value in early cases. Attention to the bowels so as to avoid straining at stool must be observed. Tight strapping of the buttocks together, preferably as part of a low back strapping may afford some relief.

The use of an inflated rubber ring, for all sitting activities is very helpful. The size of the ring is important. If the diameter is such that the gluteal muscles are put on a stretch, increased discomfort may result. It should be considerably wider than the distance between the midpoint on each buttock. It should be inflated sufficiently so that the weight is borne entirely by the structures resting on the perimeter of the ring. Its particular advantage and usefulness is obvious in thin individuals. The ring may be enclosed in a pillow cover for those using the ring in an office. Its use should be continued until after the disappearance of the symptoms.

Prolonged applications of heat are important. Hot sitz-baths, may be prescribed. Rectal irrigations are difficult for the patient to use effectively at home. Local elevation of temperature by diathermy is of value in most cases when used properly. Careful massage through the rectum is tolerated in some instances and is of real help.

Injection of alcohol was advocated by Yeomans[20] on the basis that following

trauma contracture occurred in the dense surrounding tissues with nerve compression. Ten to 20 minims of 80 per cent alcohol was injected at the most tender spot, inserting one finger into the rectum to avoid puncture of that structure. Usually several injections were made. Kleckner[18] advocated quinine and urea hydrochloride as an agent for injections. Excision is not indicated as an immediate form of treatment in this type of case.

SUMMARY

The anatomy of the coccyx is reviewed, and considered from the standpoint of injury and as the site of coccygodynia. Fractures and dislocations, both from external and internal forces are discussed with their treatment.

Comments are made upon the various etiological possibilities of coccygodynia. Those cases resulting from trauma are considered most important and the treatment outlined in some detail.

REFERENCES

1. Gray. Anatomy of The Human Body. Ed. 21. Phila., Lea and Febiger, 1924.
2. Lewin, P. Coccyx, its derangements and their treatment. *Surg. Gynec. and Obst.*, 45: 705 (Nov.) 1927.
3. Meekren, Jobi A. Observationes medico-chirurgicae ex Belgico in latinum translatae ab Abrahmao Blasio Amsterdam, Henrici & Viduae, Theodori Boom 1682.
4. Cyriax, E. F. Minor displacements of the coccyx. *Glasgow Med. Jour.*, 98: 98 (Aug.) 1922.
5. McCusker, H. Injuries of the coccyx. *Rhode Island Med. Jour.*, 17: 77 (May) 1934.
6. Vermillion, E. L. Injuries to the coccyx. *Jour. Kansas Med. Soc.*, 30: 217 (July) 1929.
7. Jolly, W. J. Fracture of coccyx and passage of the segment per anum. *Med. Record*, p. 762 (Dec. 7) 1887.
8. Gant, S. G. Diseases of the Rectum, Anus and Colon. Phila., W. B. Saunders Co., 1923. Vol. 1, chap. IX, p. 160.
9. Da Costa, J. C. Modern Surgery. Ed. 9. Phila., W. B. Saunders Co., 1925.
10. Nott, J. C. Facts illustrative of the practical importance of a knowledge of the anatomy and physiology of the nervous system. *New Orleans Med. Jour.*, 1: 57 (May) 1844.
11. Simpson, Sir James Y. Ed. by Alexander R. Simpson. Clinical Lectures on Diseases of Women. New York, 1872.
12. Simpson, Sir James Y. Clinical Lectures on Diseases of Women. Phila., Blanchard & Lea, 1863, Lecture XVII, p. 209.
13. Barnes, Robert. A Clinical History of the Medical and Surgical Diseases of Women. Phila., H. C. Lea, 1878.
14. Jenks, E. W. A lecture on coccygodynia. *Med. Record of New York*, 17 (April 17) 1880.
15. Burnett, S. G. *Med. Herald and Physic. Therap.*, 49: 287 (Aug.) 1930.
16. Hamill, Ralph C. Coccygodynia. *Med. Cl. N. Am.*, 5: 37–44 (July) 1921.
17. Drueck, Chas. J. Coccygodynia. *Jour. Indiana Med. Assn.*, 19: 275 (July) 1926.
18. Kleckner, M. S. Coccygodynia: the present day interpretation and treatment. *Tr. Am. Proc. Soc.*, 34: 100, 1933.
19. David, V. C. Tuberculosis of the os coccygis. *J. A. M. A.*, 82: 21 (Jan. 5) 1924.
20. Yoemans, F. C. Coccygodynia—a new method of treatment by injections of alcohol. *Med. Record*, (Aug. 22) 1914.

FRACTURES OF RIBS

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THERE is no doubt that in the last twenty-five years the incidence as well as the seriousness of injuries is increasing tremendously. The impact of the forces are greater, possibly due to our greater speed in industry and travel. It is for this reason that fractures take such an important place in surgery to-day.

Fracture of the ribs may be the only injury sustained by an individual or it may be only a small part of the injuries sustained because of the usual multiplicity of injuries seen following automobile and industrial accidents. Where the rib fracture is the only injury and barring complications, then we are dealing with a so-called minor surgical condition or one that may be treated by office procedure.

ANATOMY

Briefly in review each rib has a posterior or vertebral extremity and an anterior or sternal extremity, the posterior extremity consists of a head, neck and tubercle. This is followed by a shaft, which is thin and flat with external and internal surfaces. The internal surface is marked by a ridge which commences at the lower extremity of the head. Between this ridge and the lower border of the rib is the costal groove for the intercostal vessels and nerve. The ribs consist of highly vascular cancellous tissue encased in a thin layer of compact bone. At the anterior end of the ribs the costal cartilages attach and join the upper seven ribs to the sternum. The eighth, ninth, and tenth articulate with the lower border of the cartilage above; the eleventh and twelfth ribs have no anterior attachment. The ribs are palpable excepting in very stout persons. They are very elastic and this elasticity is enhanced by the attachment of the costal cartilages. The first and second ribs are well protected by the clavicle. Likewise the eleventh and twelfth ribs are rarely if ever fractured because these two ribs, not being attached anteriorly, move away with any force which may be applied to them.

Fracture of the ribs by trauma seldom occurs in children with the exception of forces which actually crush the chest severely, well beyond the wide elastic limit of these young ribs and cartilages. Violent muscular spasm as occasionally seen in pertussis has at times fractured one or both first ribs. Most cases occur in middle life, about forty years of age, where the individual is most active and more exposed to injury. For this same reason the male predominates over the female by 4 to 1.

Direct violence from falls and blows, in which case the fracture is usually located at the point of contact of the force, is the most common exciting factor. Indirect violence as by compression usually allows the fracture or fractures to occur at the weakest point of the rib, just in front of the angle of the rib. I have seen a case in which the amorous embrace of a husky lover compressed the chest violently enough to fracture three ribs. Muscular violence is a more common cause of fractured rib than usually thought. It is commonly reported in tuberculosis resulting from violent coughing. There are over 66 cases in the literature of this type. Any rib may be broken by muscular violence and it occurs in multiple ribs and there are cases of bilateral occurrences. Muscular violence sufficient to cause fracture of the ribs has occurred in parturition, vomiting, sneezing, straining at stool and lifting heavy objects. Usually fracture of

the ribs following this trauma is a linear fracture without displacement and not easily seen on an *x*-ray picture. The case is treated as a "dry" pleurisy especially when the fracture occurs from coughing, as in a tuberculous patient. Sometime later the patient is radiographed again to note the condition of the lung process when the roentgenologist notes a definite callus at the site of the previous pain, more readily visible than the minute linear fracture easily missed in the earlier plate.

Fractures may be partial or complete. Most partial fractures occur by muscular spasm either in children or adults. If the muscular spasm is very violent complete fracture occurs and at times even displacement. All other forces direct or indirect cause complete fractures. Fractures may be single or multiple involving many ribs or more than one fracture in a single rib. Crushing injuries not invariably cause bilateral, multiple fractures.

The first, second, eleventh and twelfth ribs are rarely fractured; but in the first and second, most of these have occurred by muscular violence as a result of coughing. In the third and tenth ribs the involvement is usually at points from the midaxillary line forward, where the ribs are most exposed to direct blows. In compression the bending of the ribs occurs to the breaking point usually the weakest point or just in front of the angle of the rib. Displacement occurs depending on the length of time that the force is applied so that we get overriding of the fracture ends or vertical displacement of the fragments. By the fact that the ribs are protected by the intercostal muscles and that the periostium may not be broken on both the anterior and posterior surfaces of the ribs, displacement is not great.

As in all other fractures, so in fractures of the ribs compounding may occur, either through the skin or through the parietal pleura. Compounding through the skin is not often encountered, but compounding through the parietal pleura or into the lung is more common. Compounding through the skin occurs when the impacting object is sharp enough to lacerate the skin. Compounding inward occurs by the force of the impact continuing long enough to actually push the fractured end of the rib into the parietal pleura and into the lung.

The complications that may arise from fracture of the ribs are often very serious and may easily lead to death. They may be listed as follows:

1. Pneumothorax, simple or valvular type causing tension pneumothorax;
2. Hemopneumothorax;
3. Subcutaneous emphysema;
4. Mediastinal emphysema;
5. Paralytic ileus;
6. Lung abscess;
7. Intercostal nerve and blood vessel injury;
8. Hemoptysis;
9. Pneumonia.

The symptomotology of rib fractures usually leads to the diagnosis. A history of trauma is always given unless the patient is unconscious. He tells you that he fell against some object hitting his chest against the object, or that his chest was crushed, or a history of severe cough, sneeze or hearty laugh may be given. Immediately following these traumas the patient experiences severe pain in the chest or calls it a stitch in the side. The pain is severe, lancinating and definitely increased by deep breathing. The patient very often holds the injured side with his hands and bends his body toward that side. At times he points to the one localized area of tenderness.

In order to examine the chest to determine the location and number of ribs fractured, palpation is of greatest aid. A localized area of tenderness with or without crepitus usually points to the site of fracture or fractures. An excellent way to elicit this is to put pressure on the chest wall with one hand anteriorly and one hand posteriorly. The patient will usually point to the point of greatest pain.

In the fracture resulting from muscular violence, after coughing, sneezing, laugh-

ing, etc., pain occurs very suddenly during these acts and is manifested by a sudden onset of severe pain, and since this type of fracture often occurs in cases of tuberculosis, the inference is that the patient developed a pleurisy which would account for the same type of pain.

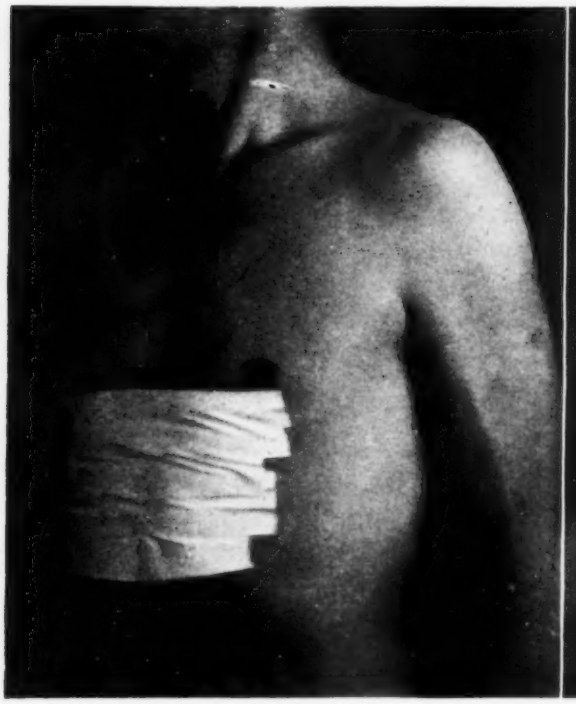

Fig. 1. Adhesive beyond mid line anteriorly and posteriorly.

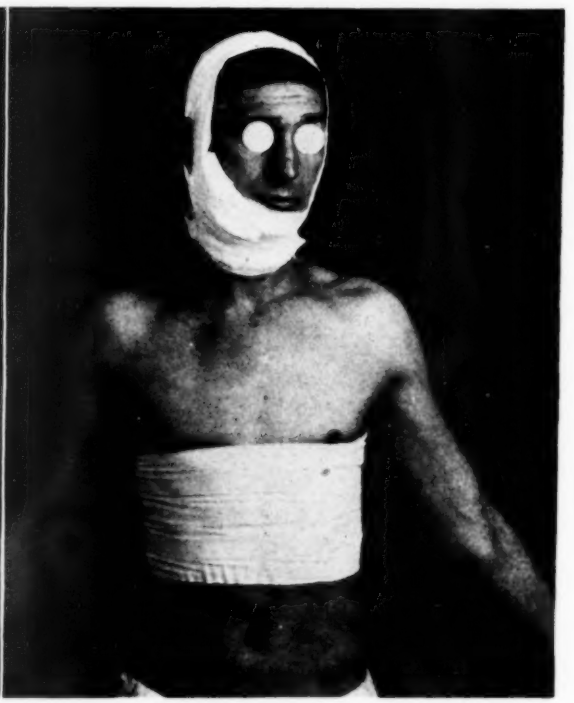

Fig. 2. Adhesive completely encircling chest.

The symptoms and signs associated with the complications of rib fractures are usually easily picked up on examination. The degree of surgical shock is great, this alone makes one suspect that a complication has occurred. Hemoptysis occurs when the lung has been injured by the blow or by a piercing rib. However, it is not uncommon to discover a tuberculous lesion which may have been quiesent until the injury and trauma to the chest wall without laceration of the lung cause hemoptysis due to the diseased lung. Hemothorax, pneumothorax and hemopneumothorax in addition to the marked shock show severe dyspnea as well as the physical signs that go with these conditions. Subcutaneous emphysema can easily be felt and by observation one can easily determine if it is progressive or localized.

Paralytic ileus as a symptom comes on usually after twenty-four hours and one must suspect an intra-abdominal associated injury when this occurs. There are, however, a few cases in which this complication was so severe that it led to death and yet at autopsy no other lesion than fractured ribs could be found.

After the clinical diagnosis is made, an *x*-ray picture is necessary to confirm the condition as well as to add some information as to the chest contents. However, it must be remembered that not infrequently roentgenogram of the chest fails to bring out the fracture. This is unfortunate as there are many compensation insurance companies who feel that every fractured rib so diagnosed clinically should be confirmed by *x*-ray findings.

In fractures of the first ribs unilateral or bilateral the fracture is most often picked up three to four weeks after its occurrence because at this time enough callus has

been thrown out to show the point of fracture.

The differential diagnosis rests between a dry pleurisy with its agonizing pain on inspiration and expiration. The history of trauma and eliciting crepitus clinches the diagnosis. In pleurisy there is usually no localized tenderness on palpation or by applying pressure to the chest.

Having once made the diagnosis the patient is very anxious for quick relief from his severe pain or "stitch" in the side. The treatment barring complications is usually ambulatory. Immobilization of the chest wall is attempted to limit the free excursion during inspiration and expiration. This is best accomplished by strapping the chest over its lower half. When properly applied, relief is almost instantaneous. The immobilization is left on for two weeks. The patient is usually comfortable and often, if his work is not too hard, may continue to work. At the end of two weeks the strapping is removed and usually all pain is gone but localized tenderness persists. The rib is not completely healed yet but there is some callus present as seen in the *x*-ray film. The chest is restrapped and this is left on for another two weeks. Now all immobilization may be removed. Callus is usually well formed and healing almost complete, although slight tenderness may persist. The patient has a slight amount of pain, usually lasting for a short period of time. Emphysema or hemoptysis are not contraindications to immobilization nor is pneumothorax. However, these symptoms require bed rest in addition to the immobilization.

The methods of immobilization of the chest are as follows:

1. Strapping with adhesive beginning at the lower costal margin and completely encircling the chest. The plaster is most often only applied from 2 inches beyond the midline posteriorly to 2 inches beyond the midline anteriorly on the affected side.

To apply the adhesive a hairy chest should be shaved. The patient extends the arm on the affected side and supports himself against the wall. The adhesive is applied in deep expirations, usually using three strips of adhesive 2 inches wide beginning at the lower costal margin and going upwards on the chest.

Fig. 3. Sam Browne plaster.

2. Another excellent method is by the use of plaster-of-Paris and making a Sam Browne belt. Plaster strips 4 inches wide girdle the lower chest and are applied in expiration. An extension plaster strip is run over the shoulder, going from the girdle of plaster anteriorly over the shoulder to the girdle of plaster posteriorly. This immobilization is left in place for four weeks and then removed.

Sedatives may be necessary and if there is a cough, codein sulphate grain ¼ every three to four hours, acts well.

The treatment of the complications usually require bed or hospitalization and therefore beyond the scope of this paper.

SUMMARY

The first and second ribs, although well protected, do sustain fractures by indirect violence, usually muscular. In children,

fracture of the ribs is rare, except for severe crushing injury. It may be a serious injury with many complications, and even lead to death. Immobilization by any one of the three means described, is the treatment of choice.

REFERENCES

Ballou, H. C. and Francis, B. F. *Arch. Surg.*, 19: 1627, 1929.
Bistalfi, S. *Radiol. Med.*, 17: 1255, 1930.
Bohler, L. Treatment of Fractures. Ed. 2 and Ed. 4.
Bonson, G. *Brit. Med. Jour.*, 346 (March) 1928.
Brown, O. A. *Southwestern Med.*, 13: 445, 1929.
Browning, C. C. *Am. Rev. Tuberc.*, 25: 571, 1932.
Christopher, F. *Ann. Surg.*, 90: 394, 1929.
Conroil, G. J. *Arch. Surg.*, 18: 394, 1929.
Dunlap, H. A. and Koleu, M. *Lancet*, 1: 452, 1930.
Friedl, E. *Roentgenpraxis*, 5: 881–882, 1933.
Funston, R. V. *Jour. Bone and Joint Surg.*, 13: 174, 1931.
Goodluffe, Robert V. *Brit. Med. Jour.*, 153 (Jan.) 1929.
Hammon, Roland. *Jour. Bone and Joint Surg.*, 17: 233–234, 1935.
Harvey, Joseph L. *J. A. M. A.*, 94: 21, 1930.
Hawson, Carl R. *Am. Rev. Tuberc.*, 30: 566, 1934.
Meyer, Paul. *Deutsch. Zeitschr. f. Chir.*, 244: 395, 1935.
Money, R. S. *Med. Jour. Australia*, 16: 440, 1929.
Pittawa, H. F. *Roentgenpraxis*, 4: 1011, 1932.
Richardson, Eric C. *J. A. M. A.*, 106: 1543 (May) 1936.
Scudder, Charles. Treatment of Fractures, Ed. 9.
Speed, Kellogg. Text Book of Fractures and Dislocations, Ed. 3.
Spyrapoulos, Charles. *Chirurg*, 3: 1052, 1931.
Tiegel, Max. *Zentralbl. f. Chir.*, 58: 1264, 1931.
Waugh, R. L. *Jour. Bone and Joint Surg.*, 17: 1067, 1935.
Weldon, R. P. *Ind. Med. Gazette*, 65: 330, 1930.

PATHOLOGY AND TREATMENT OF GANGLION*

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PHILADELPHIA

GANGLION is one of the troublesome lesions met in a minor surgical practice. Historically, it has been known since the time of Hippocrates, who is said to have referred to ganglion as "mucoid flesh." From that time until the eighteen hundreds very little was written on the subject. Between 1847 and 1893 various hypotheses were presented. Retention cysts arising from the subsynovial membrane, crypts and follicles were classified as "mucinous tumors." Ganglia were also referred to as synovial dermoids and serous cysts. Others considered them of neoplastic origin. Vogt,[1] in 1881, suggested that they arose from bursa. In the latter part of the nineteenth century Ledderhöse advanced the theory that they arose by cystic degeneration from the connective tissue around a joint or a tendon sheath. In 1928, Carp and Stout[2] made a review of the literature and careful microscopic studies, concluding that a ganglion was produced by the mucinous degeneration of connective tissue in or attached to capsules of joints or tendon sheaths. In 1932, King,[3] of the University of Melbourne, suggested a theory of proliferation of connective tissue with the accumulation of excessive extracellular secretion of mucinous material and the formation of cavity. He concluded that the process is not primarily a degeneration of cellular structures but is a secretion with the formation of a pseudo joint cavity in specialized connective tissue.

A ganglion may be defined as a cystic benign tumor, filled with a mucoid material usually surrounded by a thin wall and occurring in the region of the capsule and connective tissue of joints and tendon sheaths. In accordance with other writers, we find a greater occurrence of the tumor mass in the second, third and fourth decades of life, the majority of patients being of slight build. The reason for this has never been explained fully. It is also evident that there is a sharp decline of the incidence after the fourth decade of life and that such cysts are of comparative rarity in old age. The fact that the greatest number of cases occur in early active life, when trauma is most likely, may have a definite bearing on the cause. In our series of 50 cases, 19 patients definitely gave trauma as the cause; 29 were unable to name any specific etiologic agent. Only 2 were certain that trauma had not occurred. The majority of cases listing trauma state that it is associated with a twisting motion. Such an example is well illustrated in the case of a seventeen year old boy who developed a typical ganglion of the dorsum of the wrist following repeated lifting of heavy milk cans from a loading platform into a truck. A girl of twenty-one years had a ganglion of the same type due to a strain from playing tennis. Another gave the cause as the repeated lifting of heavy ledgers. The wringing out of wet clothes was given by several housewives as the probable cause. The pressure of the knee against a machine while pushing down a lever with the foot was the cause of a ganglion on the lateral aspect of the knee. A ganglion developed on the dorsum of the foot following the painful trauma of kicking a chair. Another occurred on the flexor surface of the fifth finger from bowling. A street car employee had his hand jammed between a plank and a piece of steel; ten

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days later a swelling appeared at the base of the thumb on the flexor surface. From these examples it may be assumed that

Fig. 1. Ganglion of dorsum of foot which developed after a truck wheel had passed over the patient's foot. Cure followed excision.

trauma plays a part in the etiology of ganglia (Fig. 1). It is likewise true that strains and traumata occur to the tendon sheaths and joints without the formation of ganglia.

King believes that there is also a constitutional factor which plays an important role, for the ganglion is sometimes seen to regress as the general condition of the patient changes, without traumatic rupture of the mass.

PATHOLOGY

Because of the apparent inefficiency of the treatment of ganglia we have been prompted to reexamine the pathology of this lesion. It is the hope that a clearer understanding of the mechanism of the production of these lesions may lead to improved methods of therapy.

On gross examination the excised ganglia have, in our experience, varied in size from a tiny globule, 0.5 cm. in diameter, to a mass which measured 6 by 3 by 2.5 cm. They may be solid, or show varying degrees of cyst formation. If multiloculated, the loculi may be of approximately the same size or there may be one large and several smaller ones. The contents are usually colorless. The consistency varies; rarely it may be fluid but more commonly it has the viscosity of glairy mucus.

For some years it has been the teaching of one of us that ganglia arise from degenerations of mesoblastic tissue with the formation first of solid masses which gradually become cystic. This process of evolution has the support of King[3] who has recently presented a paper in which he divides the development of ganglia into three stages. We present photomicrographs which depict his classification (Figs. 2, 3 and 4). His idea is that a metaplasia occurs in the specialized connective tissue around joints and tendon sheaths. Spheroidal cells develop in scattered closely packed groups. These cells are seen to possess a vacuolated protoplasm and a central round nucleus. Around the periphery of the grouped spheroidal cells, there is a gradual change into spindle cells. As the droplets accumulate in the vacuolated spheroidal cells, this secretion is discharged into the tissues between them (stage I). The process continues until the extracellular collection of the secretion separates the cells more widely. Finally enough of the mucinous material has been secreted to fill a large portion between the cells and now has the appearance of a small cavity (stage II).

Numerous groups of spheroidal cells carry on this process until there are multiple cystic formations. These gradually merge with each other due to atrophy of the intercystic septa, giving rise to larger spaces. As the process ceases, the cells become less spheroidal in appearance and finally return to their original spindle shape (stage III). In all these developmental stages of the cyst there are always associated a number of smaller cysts and a few scattered nests of spheroidal cells in close proximity.

It must be confessed that one of the senior pathologists, on reviewing our sec-

tions, stated that it took some imagination to follow the transition between stage II and stage III. He tersely remarked that "imagination is a bad thing for a pathologist to have." The coalesence of the small cysts to form larger ones is apparently definite, however (Fig. 5).

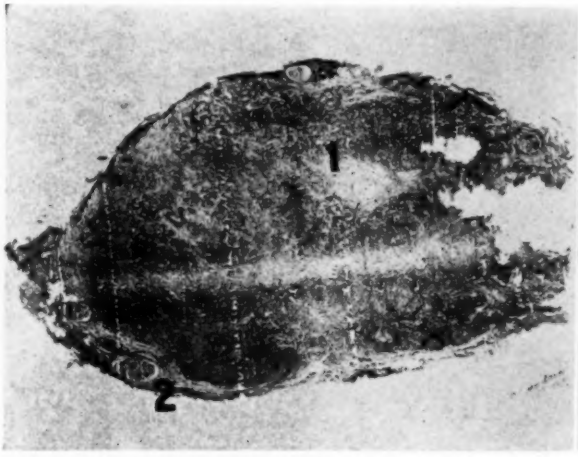

Fig. 2. Ganglion removed from over flexor tendon sheath in hand, at metacarpophalangeal joint; pathologically classed as stage I or very early ganglion (King's classification). It shows one area of early cyst formation (1) and numerous involved nerves (2) at the periphery.

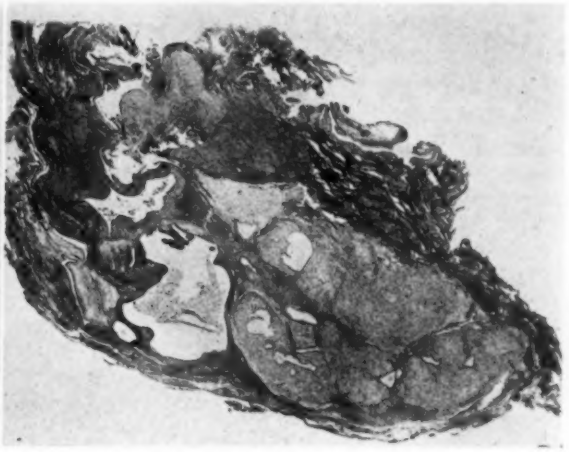

Fig. 3. Ganglion removed from extensor tendon sheath at wrist; pathologically classed as stage II or moderately well developed ganglion (King's classification).

By the use of differential staining, several points of both clinical and pathological interest have arisen in this study. It has generally been believed by previous writers[2] that ganglia have a mucinous content, and indeed it does give some of the chemical reactions of this ill-defined group of glycoproteins. However, by the use of Mayer's mucicarmin stain, we have been able to show that the contents of ganglia are probably myxoid rather than mucinous. This differentiation becomes of importance when it is viewed in the light of King's theory that the content of ganglia is a secretion rather than a degeneration. We are prone to question this since, with the exception of the eye, there are but few places in the body where myxoid tissue occurs as a secretion. Thus in summary the writers view the process as a specific degeneration of the collagen fibres, as is shown by Mallory's phosphotungstic acid stain.[4] The elastica are diminished in number, and the reticulum, shown by Laidlow's silver stain,[5] persists until complete cyst formation. There is evidence of hyaline change around the areas undergoing myxoid degeneration. Whether these two processes are going on concurrently or whether the myxoid tissue arises in the hyalinized areas is not clear. Ziehl-Neelsen-Gabbet stain[6] for tubercle bacilli gave no indication of the presence of these organisms.

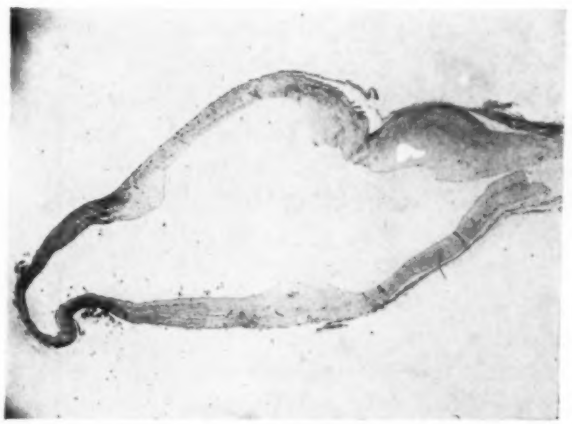

Fig. 4. Ganglion removed from the extensor tendon sheath at the wrist; pathologically classed as stage III or fully developed ganglion (King's classification). There were several areas at the periphery which showed early degenerative change.

All three of our cases which were classed as early (stage I) gave definite evidence of chronic inflammation. This was shown by round cell infiltration (Fig. 6) and in one

section by an occasional polymorphonuclear leucocyte. Marked perivascular fibrosis was seen in these sections. It is noteworthy that in that late ganglia (stage III) there was almost no chronic inflammation and in general there was less fibrosis in the walls of the vessels. Several of our sections contained portions of nerve tissue. In every case it showed degenerative change. It is probable that this may have accounted for the pain noted by these patients.

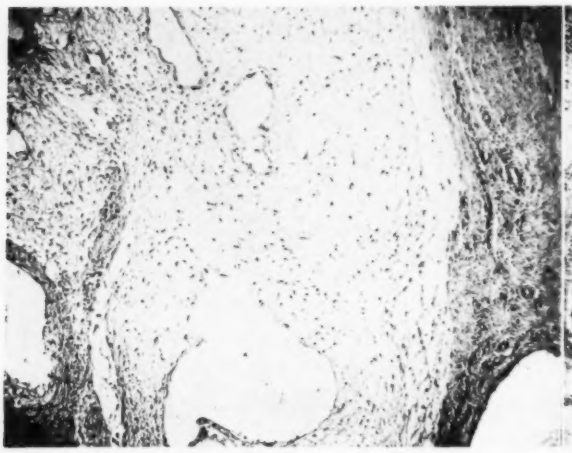

Fig. 5. Photomicrograph showing coalescence of small cysts to form larger ones (same case as Fig. 2).

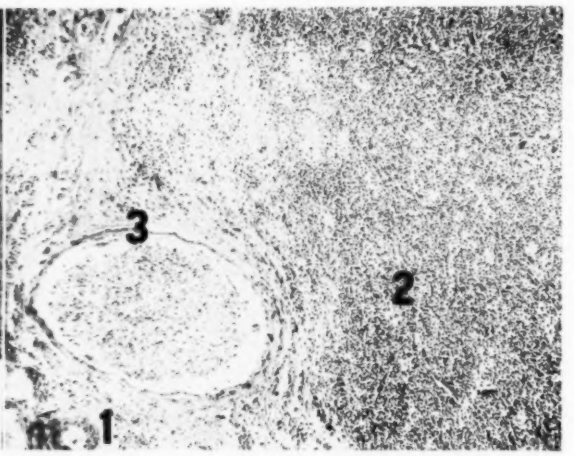

Fig. 6. Early ganglion showing fibrosis of the vessels (1), round cell infiltration (2) and degeneration of an involved nerve (3).

Most important clinically was the observation that in all save the very early cases there was noted degeneration at the periphery of the cysts. This was best demonstrated by the mucicarmin stain. At the outer margins, localized areas which had taken a pinkish stain could be seen. These were surrounded by apparently normal tissue. Such areas conveyed the impression that portions of degenerating tissue had been left behind in the excision of the ganglion. It is probable that these areas not excised may account for the reappearance of ganglia following excision. They suggest the necessity of a complete and fairly wide excision if recurrence is to be avoided.

In discussing the pathology of ganglion another observation should be pointed out. The degeneration of connective tissue to form ganglia is not found only in connection with joint tissue and tendon sheaths. It may occur in other connective tissues. In this group of cases are 3 in which the ganglion had no connection with either joint or tendon. Two of them appeared on the dorsum of the distal phalanx of the thumb and one involved the peroneal nerve (Fig. 7).

SYMPTOMS

The most prominent symptom is the presence of a mass. This is probably because the most frequent site of ganglion is the dorsum of the wrist and other extensor surfaces. The swellings may be uniform in size or may consist of a multilocular mass. Occasionally there may be a decrease in size, later followed by enlargement. Cysts such as are found on the palm of the hand are not evident on the surface.

Pain is variable. This may be described, when present, as usually dull in character, more or less persistent and most marked upon motion of the neighboring joint and tendons. Ganglia occurring on the flexor sheaths over the metacarpophalangeal joints are painful when pressed upon by a hard object (Fig. 8). Weakness of the wrist, finger and toe may be a complaint, when ganglia are present.

Depending on its content, the ganglion may be tense and firm to palpation or soft and fluctuant. It may be bony hard when

the wall is thick and the contents a semi-solid gel. Others may be fluctuant, especially when multilocular. They are usually attached to the deeper underlying structures and may be felt to move on motion of the neighboring joint or with the involved tendon sheath.

Fig. 7. Ganglion of dorsum of distal phalanx of thumb developing in connective tissue which has no relation joint or tendon sheath.

Fig. 8. Ganglion of the flexor tendon sheath in the hand. Small circles represent most frequent sites of these lesions. Excision is the only method of treatment.

TREATMENT

The indications for treatment of ganglia are three in number: (1) the desire of the patient to remove the unsightly mass produced by the ganglion, (2) the relief of the feeling of weakness of the part often noted when a ganglion is present, and (3) relief of the pain or soreness which frequently accompanies the presence of ganglion.

Three methods have been used in our hands in treating ganglion; they are rupture, aspiration and excision.

Rupture. Rupture with dispersion of the contents of the ganglion has been regarded as the most conservative method of treatment. The rupture is accomplished by striking the ganglion sharply with a heavy object, usually a book. This method is applicable only to ganglia which may be made prominent, such as those on the dorsum of the wrist (Figs. 9 and 10). No anesthesia is required. After the ganglion is ruptured the area is massaged so that the gelatinous contents may be dispersed and absorbed in the surrounding subcutaneous tissues. We have carried out this form of treatment with the knowledge that recurrence may take place, but since a cure is obtainable by simple rupture in at least one-half of the cases, it seemed this conservative treatment was worth at least one trial. Our experience with 32 cases showed a permanent cure without recurrence in 16, or 50 per cent. In 16 cases recurrence took place, making the failure percentage equal to cure percentage by this method of treatment. In 10 other cases we were unable to produce rupture and excision was performed.

Aspiration. The treatment by aspiration of the ganglion contents has been disappointing (Fig. 11). In many cases the contents of the ganglion is of such a firm jelly-like consistency that aspiration has been unsuccessful. In other cases the multilocular character of the ganglion has made it difficult to be certain that the con-

tents were entirely evacuated even though some of the gelatinous material could be removed. We have avoided the injection of irritants as has been recommended by some writers because of the uncertainty of the injection. Seven cases have been treated by simple aspiration under local anesthesia and of these only one case was permanently cured. For this reason we have discontinued this form of treatment.

Fig. 9. Ganglion of dorsum of the wrist showing ganglion made prominent by flexion of the wrist in preparation for rupture and dispersement.

Fig. 10. Ganglion of palmar surface of wrist. Ganglia in this location cannot be treated by rupture.

Fig. 11. Large ganglion of palmar surface of finger treated unsuccessfully by aspiration with later excision and cure.

Excision. The most successful method of treatment in our hands has been careful dissection and excision of the ganglion. Whenever possible, a tourniquet is used to produce a bloodless field. This insures a more rapid and accurate dissection. The operation may be performed under local infiltration anesthesia of 1 per cent procain hydrochloride. With strict aseptic precautions and retraction to keep the sides of the wound on tension, the ganglion is separated from the surrounding tissue by blunt and sharp dissection. At its base it is wise to excise a fairly generous amount of the surrounding tissue. This we feel is the best insurance against recurrence.

If the capsule of the joint or a tendon sheath is opened, it is carefully closed with interrupted sutures of fine catgut or silk. After the closure of any dead space in the same manner, the skin is sutured with a vertical mattress stitch of black silk thread. A firm compression bandage is applied and the part splinted when possible. The patient is ambulatory throughout his treatment. With this type of therapy we operated upon 18 patients with complete removal and cure of 15, or 83.3 per cent. There was a recurrence in 3 cases, or 16.7 per cent. Of the recurrences 2 were cured by subsequent rupture, one by excision.

SUMMARY

1. A study of ganglia is presented with the review of 50 personally treated cases. We are inclined to the belief that trauma is a definite etiologic agent.

2. From a pathological study we have been able to confirm King's idea that these masses appear first as a solid tumor mass with later formation of small cysts which progress to the formation of larger cysts by the disappearance of the intercystic septa.

ANALYSIS OF CASES

Age in Years	Male	Female	Total
11–20	7	8	15
21–30	8	13	21
31–40	3	3	6
41–50	2	2	4
51–60	0	1	1
61–70	2	1	3
	22	28	50

ANATOMICAL LOCATION OF GANGLIA

Dorsum of wrist	29
Palmar surface of finger	8
Flexor surface of wrist	3
Dorsum of foot	2
Dorsum of finger	2
Dorsum of toe	2
Lateral aspect of knee	3
Popliteal space	1

3. Various staining methods have led us to believe that the contents of ganglia are myxoid rather than mucinous and therefore the process is one of degeneration of collagen fibres rather than a secretion of connective tissue cells as suggested by King.

ANALYSIS OF TREATMENT

Method	Cases	Cures	Per Cent	Recurrences	Per Cent
Rupture	32	16	50	16	50
Aspiration	7	1	14.3	6	85.7
Excision	18	15	83.3	3	16.7

4. Recurrence of ganglion following rupture or excision probably takes place due to a continuation of the degenerative process in tissues adjacent to the original ganglion.

5. By simple rupture and dispersion, a permanent cure can be expected in about 50 per cent of cases. By excision a cure can be expected in about 85 per cent of cases. Best results are obtained by a fairly wide excision of the tissues surrounding the ganglion in order to be sure that all the tissue undergoing myxoid degeneration be removed.

REFERENCES

1. Vogt, Paul. *Deutsche Chir.*, 64: 158, 1881.
2. Carp, L. and Stout, A. P. *Surg., Gynec. and Obst.*, 47: 460–468, 1928.
3. King, E. S. J. *Australia and New Zealand Jour. Surg.*, 1: 367–381, 1932.
4. Mallory, A. M. and Wright, J. H. Pathological Technique, Phila., W. B. Saunders, 1918, p. 71.
5. Laidlow, G. F. *Am. Jour. Path.*, 4: 239–247, 1929.
6. Mallory, A. M. and Wright, J. H. Pathological Technique, Phila., W. B. Saunders, 1918, p. 352.

COLLES'S FRACTURE*

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FROM a study of the many excellent articles that have been published on Colles's fracture, it may be concluded that its treatment is well understood. There also seems to be little doubt that the principles underlying reduction are appreciated and that the pitfalls of treatment are well in mind. Yet, in spite of this general knowledge of the handling of the fracture, the results, on the whole, are far from satisfactory, especially in elderly cases.

In the experience of this Clinic, a Colles's fracture is often seen that has not been completely reduced. In view of this tendency toward imperfect reduction, further emphasis must be placed upon proper handling of the fracture, to obtain full reduction, not partial reduction, of the deformity.

In the first place, this fracture should be reduced promptly. Since it is a fracture near a joint, it should be reduced completely. If deformity persists near joints, chronic changes soon appear. Older people often develop arthritic changes following a fracture, but in the presence of persisting deformity these changes with the resultant loss of function become greatly exaggerated.

In the ordinary Colles's fracture there is the well known silver-fork deformity. The lower radial fragment is displaced backward and also toward the radial side. In older patients the fragment is often comminuted. In some cases the tip of the ulna is broken off by the pull of the carpal ligament. If the ulnar tip is not fractured, then in any case the ulnar ligament is torn. For this reason, a point of tenderness often persists on the outer side of the wrist where reattachment of the ligaments is taking place, and such tenderness may be present long after a well reduced fracture has healed.

The opinion is sometimes expressed that the fragments in a Colles's fracture are "impacted." It is to be noted, however, that there is no stability or fixation of the fragments. Within a week after the fracture the fragments loosen in the normal healing process.

There are other complicated forms of Colles's fracture where displacement is considerably more severe, as in the T fracture into the joint. In such cases the fragments may separate as much as ¾ of an inch. Such complications are important when it comes to reduction measures.

In children the Colles's fracture is represented as a separation of the lower radial epiphysis with displacement backward.

Successful reduction of this fracture depends to a great extent upon an understanding of the anterior palmar tilt of the lower end of the radius. The axis of the plane of the wrist joint is about 15 to 20 degrees from the longitudinal axis of the radius. This change in plane is due to the curve of the radius and to the tilt of the joint surface. Oftentimes when the *x*-ray study of the fracture is made, the displacement of the lower radial fragment is seen to be very slight, that is, only a fraction of an inch, but the deformity in the angle of the joint may be a full 50 degrees. Thus, it is essential to appreciate the angle of deformity in a fracture near the wrist joint that has apparently only slight displacement.

One of the greatest errors made in handling Colles's fracture is that reduction is seldom sufficiently complete to restore the anterior tilt of the radial end. The orthopedic surgeon, the general surgeon, or the

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general practitioner pulls the wrist down by some particular method and considers reduction to be complete. It may, in fact, be

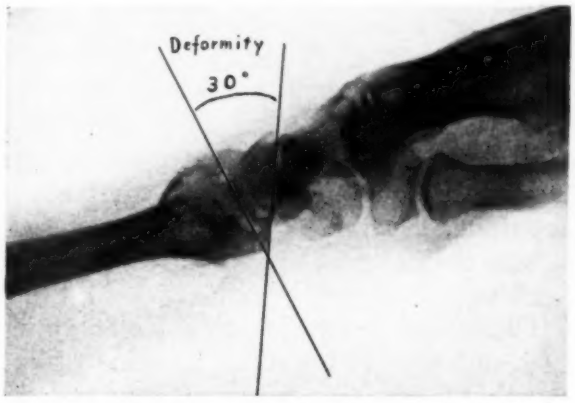

Fig. 1. Roentgenogram showing an incompletely reduced fracture with a 30 degree deformity.

close to perfect, even to within 10 degrees, and there is no backward displacement, but the end of the distal fragment is directly in line with a straight line along the radius.

Fig. 2. Roentgenogram showing a Colles's fracture with typical backward displacement and avulsion of the tip of the ulna.

The wrist joint following such partial reduction is weak, and symptoms tend to be prolonged (Fig. 1).

Attention must also be given in reduction to correcting radial displacement. Should the whole wrist be left displaced toward the thumb side, readjustment of the joint later will take much longer and prolong the symptoms.

Reduction also must be accomplished early before any absorptive changes have taken place. If treatment is delayed, the

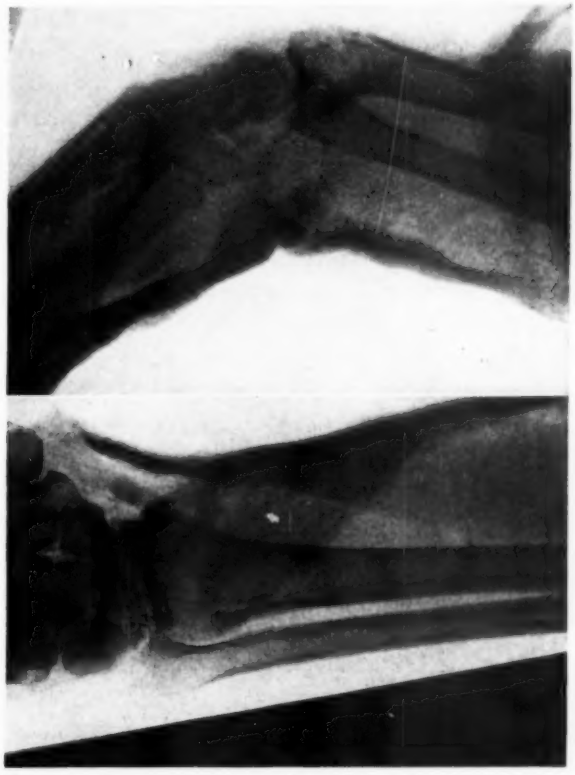

Fig. 3. Roentgenogram showing reduction of the Colles's fracture (Fig. 2) with restoration of the proper anterior tilt of the radial joint surface.

deformity becomes fixed and when an attempt is made to tilt the upper fragment back into position, the ends of the fragments will not fit together.

Reduction may be carried out under general or local anesthesia. Local anesthesia is entirely satisfactory if properly used. Not only the radial fracture cavity, but also the torn ulnar ligaments must be anesthetized, whether or not there is a fracture into the ulnar area. Otherwise, anesthesia will not be complete. Nerve block anesthesia of the brachial plexus is also very satisfactory.

The following maneuvers are carried out in reducing a Colles' fracture. (1) As in all fractures, the deformity is increased by pulling the wrist back, and the fragments are loosened; (2) the lower end of the radius is forced toward the ulnar side; and

(3) the radial fragment is pushed forward into position, letting the wrist fall into flexion. The wrist should never be jammed down in reducing the fracture; rather the operator, using his thumb on the lower end of the radius, can push it forward, giving that extra little push to bring the joint surface facing 15 to 20 degrees toward the palmar side. It is not sufficient simply to force wrist flexion to accomplish this third maneuver. Extra force must be used, and it is often the omission of this final push that causes an imperfect reduction (Figs. 2 and 3).

In the reduction of a fracture of the T type, attention is first directed to the correction of the main displacement. The wrist is pulled back to increase the deformity. When it has been well increased, the radial fragments are pushed together and then held tightly, and are brought forward in one mass. Usually these fractures are reduced without preventing spreading of the radial fragments, because so often the displacement appears to be slight. It is very important, however, to make sure that no separation exists between the fragments. If the main fractured surface is forced forward without holding the fragments together, the T fracture is under tension and the fragments spread. A spread joint means a damaged joint.

The treatment of the displacement of the lower radial epiphysis in the child is exactly the same as the treatment of the ordinary Colles's fracture in the adult. In these cases there is the danger of damaging the epiphyseal plate, which will interfere with growth. There is no way of controlling this danger except by perfect reduction.

In any fracture that is difficult to reduce, as for instance a fracture that is from two to four weeks old, a Thomas wrench may be used to help in breaking the fragments loose from callus and reducing them.

When the fracture has been reduced, the patient or nurse may hold it, without danger of redisplacement, while the plaster splint is being applied. Plaster-of-Paris strips, reinforced at the wrist and nonpadded, make a most satisfactory form of support. There are many types of splints on the market that may be used to fix the wrist, but in general they are not satisfactory. When a plaster casing is used, it is possible to mold the proper curve of the wrist. Care must be taken, if there is a great deal of swelling, to tighten the plaster casing as the swelling subsides. If this is not done, the wrist becomes loose in the plaster casing. An *x*-ray picture is taken a week to ten days after reduction.

The wrist is left in the plaster splint until union is pretty solid; a period of one month to five weeks is usually required. Meantime, the fingers are free for motion and massage may be used if swelling persists.

Colles's fracture is a simple fracture to reduce and there is little excuse for a poor result. There is no fracture that will give better results when completely reduced.

SUMMARY

The numerous unsatisfactory results of the handling of Colles's fracture, despite the general understanding of its treatment, leads the writer to direct attention to this fracture.

Imperfect reduction, due to the failure to restore the anterior palmar tilt of the lower end of the radius, is the cause of the majority of unsatisfactory results. Colles's fracture is a fracture near a joint, and if the deformity is only partially reduced, the wrist joint remains weak and chronic changes with a resultant loss of function develop.

Colles's fracture is a simple fracture to reduce and there is little excuse for a poor result. In reduction, the deformity is first increased by pulling the wrist back; then the lower end of the radius is forced toward the ulnar side to overcome the radial displacement; and finally, the radial fragment is pushed forward into position, letting the wrist fall into flexion.

FIRST AID TREATMENT OF FRACTURE OF FEMUR AND HIP*

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THE problem of first aid treatment for fracture of the femur and hip is principally the problem of transportation of the injured person. The leg must be protected and further injury prevented while the patient is being brought to the hospital. It is general knowledge that arrest of hemorrhage is essential and the relief of pain is highly desirable, but it is especially known to the fracture surgeon that proper transportation is, at least, equally important. Indeed the most effective measure for the relief of pain is the preparation of the patient for transport.

We need only refer to the work being done by the regional fracture committees to appreciate these facts. A broad study of fractures with the view of improving the treatment indicated that the first fifteen minutes after the accident was the danger period during which those perplexing and crippling complications occurred in extremity fractures. The skill and technical advances in treatment which were applied in the hospital could not overcome poor handling in the street. It is during this period that injury to the blood vessels, muscles, and nerves may be added to the already injured skeleton. Bancroft gruesomely describes "jacknifing" the patient to get him through a motor car door in overzealous attempts to rush him to a hospital. The ease with which compounding can occur under such circumstances is apparent. In the hip fractures to which the aged are subject, traumatic shock becomes the pressing problem when they are improperly transported. It was thought at one time that they had better not be treated until recovered from shock; now we know that the greatest single factor in recovery from shock is splinting the fracture and the greatest single factor in the etiology of shock is motion at the site of fracture during transportation. Adequate immobilization by simple splinting or tying the legs together is impossible. To lift a patient for the purpose of moving him a few feet can cause irreparable damage.

That badly broken legs can be moved for long distances safely and with ease after the application of a simple device was demonstrated during the World War. At that time a modification of the Thomas splint by Keller permitted its easy use by stretcher bearers. Along with traction the method is known as a fixed traction method for transportation. Its use is strongly advocated by fracture committees throughout the country. The New York and Brooklyn regional committee with the cooperation of the Municipal Department of Hospitals has instituted a plan for instruction in emergency splinting methods which is in use in the city hospitals and many of the private hospitals in the region which the committee serves.

All the ambulances are equipped with first aid apparatus which is carefully specified. The equipment consists of a fracture box which contains the necessary bandages, straps, adhesive tape, rope, slings, and clips along with a reversible Keller-Thomas leg splint and a Murray-Jones arm splint. The arm splint may be used for fractured thighs in children. All the apparatus was described and used by Kennedy and his staff[1] at the Beekman

[1] Committee on the Treatment of Fractures, American College of Surgeons, Outline of the Treatment of Fractures, 1933.

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Street Hospital. The box is kept filled by a system of exchanges where one nurse is responsible for the filling after use, and the splints are exchanged as the patient is moved from one agency to another. When the patient comes to the admitting office with a splint on, another splint is put on the ambulance to replace it, then as he is moved to a ward the admitting office takes a reserve splint from the ward. There is no loss of material or splints by any one ambulance, hospital or department. Whenever a fracture is transported by an ambulance the fracture box is exchanged for a freshly filled one.

At Bellevue Hospital a demonstration of methods of application is given by the attending staff every six months. The newly appointed house staff, most of whom will serve a term as ambulance surgeon during their service, attend. The equipment is described; methods of exchanging splints and refilling boxes discussed; and a demonstration of the method of application of all types of emergency splints is given. The internes are encouraged to apply splints to each other for practice. The members of the attending staff responsible for the care of fractures observe all injuries on admission to insure proper splinting.

In so far as fractures of the hip and femoral shaft are concerned the instructions are as follows:

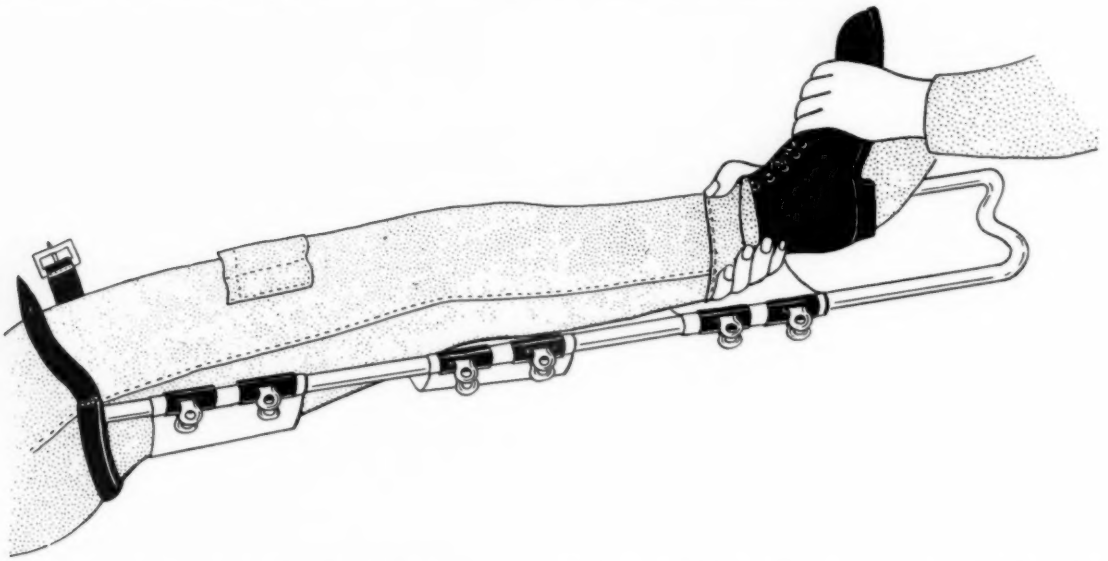

Fig. 1. Showing method of applying the traction and the splint which has been prepared and is being held under the leg while the traction is maintained.

The patient is never moved from the scene of the accident until fixed traction has been applied. No clothing is removed except in compound fractures and then only as described below. If the diagnosis is not made with sufficient certainty while the clothing remains on the patient the case is treated as a fracture and splinted until roentgenograms are taken. Not using a splint is the only error possible; its use on a contused hip, being treated as a fracture until proved otherwise, is commended.

The ambulance surgeon, in the absence of a head injury, administers one-quarter grain of morphine by hypodermic injection. He then grasps the foot of the injured leg and applies gentle traction (Fig. 1). The attempt is made to maintain this traction until such time as traction is no longer necessary in the treatment of the case. The ambulance driver or some other person is pressed into service as assistant to continue the traction. The foot is handed to him in such a manner that the pull is not interrupted. The surgeon then prepares the Keller-Thomas splint. Holding it so that the short side of the splint will be applied

to the inner side of the thigh, the half ring is bent perpendicular to the splint. Several hammock slings are clipped to the splint

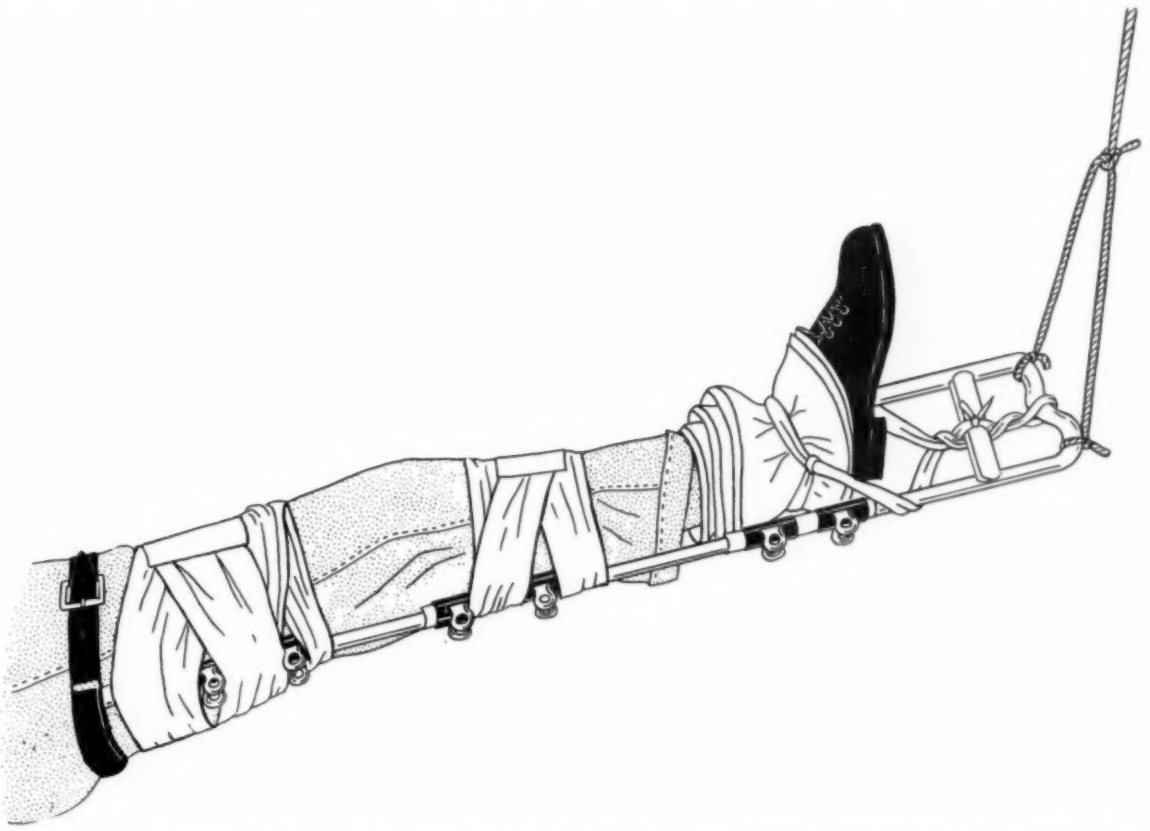

Fig. 2. The splint completely applied. Note the padding about the ankle joint and that the shoe and clothing are undisturbed.

arms in regions which will correspond to the thigh and calf. The splint is then placed under the injured leg with the ring pressed firmly against the ischial tuberosity, the lower end supported against the assistant's body.

Several layers of non-absorbent cotton are wound around the ankle region over the shoe and other clothing to protect the soft parts from pressure. Heavy shoes or trousers are a distinct advantage as they form a firm covering from which traction can be taken. The ring of the splint is completed by fastening a strap over the anterior half of the thigh at the upper end of the splint. The leg is bound to the splint by bandages encircling the leg and splint for a short distance above the knee and a similar distance below the knee. While this is being done traction is maintained by the assistant. A simple hitch arrangement as illustrated in Figure 2 is used to replace the manual traction. Muslin bandages passed over the sides of the splint, which act as spreaders, are tied at the lower end. A small block of wood or several tongue sticks are used to create a Spanish windlass which may be wound to the desired degree of traction. The assistant is thus relieved. Ropes are tied to the end of the splint to afford a means of suspending the leg from the roof of the ambulance. The patient is then carried to the ambulance on an ordinary litter.

After a few practice attempts the whole procedure can be carried out in less than five minutes, and should not take more than fifteen minutes at the first attempt. It may be taught in a few moments to any interested person whether he is aware of the principles involved or not. The main

features are traction from a well padded ankle region and a Thomas splint.

In compound fractures the procedure is precisely the same after the wound has been treated. In the presence of bleeding or obvious compounding the clothing in the region of the fracture is cut away with a scissors and a minimum of motion. A solution of one-half strength tincture of iodine is poured over the wound and a sterile dressing applied. No attempt to reduce the bones is made. If it should be reduced during the application of the traction note of that fact is made and reported to the surgeon in charge of the case. Active and obviously serious bleeding is controlled by a tourniquet. The rules concerning removal of the tourniquet at intervals of twenty minutes are carefully observed.

The patients may be left in traction for hours if they are carefully observed. The only possible source of danger is the ankle bandage. If it has been applied over a shoe with generous padding that danger is reduced to a minimum. Sensation in the foot and the ability to move the toes are sufficient indications of the degree of constriction. The traction is always adjustable.

The experience of all the fracture surgeons treating cases so transported is that most shaft fractures are reduced when they arrive at the hospital even though no express effort is made to reduce them completely. The ease with which complete reduction can be secured and permanently held is far greater than in the period before any plan for transportation was organized. That the patient is comforted and relieved of pain is well worth the effort.

Transportation in fixed traction prevents many of the complications of hip fractures in the aged. While these patients are more insensitive to pain during movement, the depth of traumatic shock seems to be in direct ratio to the amount of motion. Certainly no risk is involved in the use of fixed traction, and while there may be valid reasons for "sandbagging" some of them, the decision had better be made after careful study in the hospital. The peripheral circulatory paralysis of traumatic shock is probably the cause of most of the complications which contraindicate active and adequate treatment of hip fractures.

While this plan is a decided improvement at Bellevue Hospital it cannot be perfected by the hospital authorities alone. Unfortunately they are not the first to reach injured persons. It is difficult for many people to appreciate that they are not doing a kindness by removing an injured person to shelter or to the hospital. That a man struck by an automobile is better off lying in the gutter until an expert at removing injured people comes is hard to teach to the public. Further educational effort is therefore being directed at those most likely to come in contact with the injured, policemen, chauffeurs, street car employees, etc.

The efforts of fracture committees in large urban centers have been rewarded. There, carefully taught and supervised ambulance attendants carry out an organized scheme. In large industrial plants the control over accidents and first aid permits the use of intelligent splinting. On remote highways, however, the difficulty is great. Efficient ambulance service cannot be maintained and equipment is not available. Unfortunately the most essential part of the equipment, the Thomas splint, is not easily improvised. In those injured in high speed accidents the need is greatest and the distances to be carried the farthest. Palmer[2] suggests the enlistment of local medical societies, state highway patrols, automobile clubs, chambers of commerce, boy scouts, telephone companies, private ambulance concerns, and county officials in an educative campaign. At the present time some organizations are depositing splints at accessible roadside points such as gas stations and police stations. It is suggested that physicians carry splints in their cars.

The economic value of splinting a fracture of the shaft of the femur has been expressed in a number of ways. One aphorism states that for every minute

[2] Palmer, E. P. Airway and highway first aid stations. *Surg., Gynec. and Obst.*, 62: 446–448, 1936.

during which the patient is transported while he is unsplinted a week is added to his disability time. Palmer[2] says: "It is estimated that there is an average saving of one hundred dollars in the treatment of each extremity fracture in which the fixed traction method (for transportation) is used." It is known that fractured femurs which occur in highway accidents or civil life take longer to be rehabilitated than those which occur in well regulated industrial plants. Expert aid, in these latter cases, is always close at hand. Workers can be instructed that no injured fellow workman may be moved and that machinery must be stopped until skilled surgical aid arrives.

SUMMARY

First aid for fracture of the femur and hip is not temporary provision for the comfort of the patient. It is early treatment of the most effective kind and prevention of further injury. That the application of fixed traction at the site of the accident will prevent further injury and make the treatment eventually selected more satisfactory has been proved. Further education must be directed toward those most likely to come in contact with injured persons. At least they should be taught that no injured person may be moved until they have been properly splinted. The medical profession in general can aid in the spread of this knowledge.

OFFICE SURGICAL TREATMENT OF INJURIES OF THE KNEE

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THE term knee is used to include the joint and the structures about it. The knee joint is the largest articulation in the body and is elaborate in its structure. Its function is to support the body, maintain the upright position, and aid in locomotion. These duties subject it to frequent strains and stresses, mild or severe. When these injuries are disabling they become of special moment to the worker whose capacity to do is interrupted, and to the insurance carrier which may cover the risk under the Workmen's Compensation Laws. In all these injuries the aim of treatment is to conserve function. The extent of success or failure to do this will be the measure of loss directly to the injured, to industry and to society.

Many injuries in and about the knee joint can be safely and effectively treated in the office. These injuries may be grouped into two classes:

1. Extrinsic, or those about the joint.
2. Intrinsic, or those to the joint.

INJURIES ABOUT THE JOINT (EXTRINSIC)

Abrasions and Superficial Lacerations. Paint with iodin, remove foreign matter, debride, administer tetanus antitoxin, and cover with a sterile dressing.

Burns. Cleanse, debride, spray with 5 per cent tannic acid or apply amertan.

Contusions. Mainly important because of blood extravasation. To check this apply rest, cold and pressure. After several hours cold application is discontinued and absorption is hastened by the application of moist heat and massage.

Wounds.

1. *An incised wound* is usually clean and may be sutured after cleansing and application of iodin.

2. *A lacerated wound,* if clean, may be closed; if not clean, it should be left open.

3. *Punctured wounds* should not be closed. They may be infected, though many heal without suppuration. Probing such a wound is dangerous, it may carry infection deeper. It is not necessary to probe to determine if the joint has been penetrated. The only guide to this is the escape of synovial fluid which knowledge does not alter treatment. If the wound has been made by a pointed instrument it is usually sufficient to treat promptly with iodin, insert superficially a rubber tissue drain, cover with a sterile dressing, and immobilize the joint.

4. *A granulating wound* requires only protection. Healing may be hastened by exposure to Alpine light or an ordinary electric bulb. Sloughs should be removed. Balsam of Peru applications may hasten granulation.

Ulcers are areas of tissue destruction resistant to treatment. They follow wound infections; they result from burns due to cold, heat, chemicals or electricity. They may be influenced by constitutional disease.

Treatment. Local—cleanse, support (rest, elevation, elastic bandage); stimulate (light, scarlet red).

General. Check constitutional factor and treat, if present.

Bursitis. Exclusive of the prepatellar bursa there are some half dozen others scattered about the knee joint at points of pressure and friction. On the inner side of the knee there is (1) a large bursa between the inner condyle of the femur and the inner head of the gastrocnemius and semimembranosus, and (2) a small bursa be-

tween the tendon of the semimembranosus and inner tuberosity of the tibia.

On the outer side of the knee there is (1) a bursa between the popliteus tendon and the external lateral ligament; (2) one between the popliteus tendon and head of the tibia; (3) one between the biceps tendon and external lateral ligament; and (4) one between the external condyle of the femur and the outer head of the gastrocnemius.

These are subject to enlargement from direct trauma or from prolonged standing and exertion. The prepatellar bursa is most commonly affected. Bursitis is characterized by localized swelling, tenderness, and interference with function.

Treatment, Acute Stage. Aspiration, strapping, heat.

Chronic Stage. Aspiration with injection of an irritating fluid (iodin, phenol); heat (lamp, diathermy, short wave).

INJURIES TO THE JOINT (INTRINSIC)

Sprains are usually due to sudden twists or undue use of the joint and involve the joint, capsule or ligaments, usually the internal lateral. They are marked by pain on movement, and by swelling due to fluid in the joint.

Treatment. Immediate—Cold, followed after several hours by moist heat; rest (posterior splint, or light plaster cast for not more than ten days); adhesive strapping (must leave a gutter posteriorly to avoid circular constriction); early motion is important. *Later treatment* for the swelling, stiffness and weakness—Heat (lamp, diathermy, short wave) to promote circulation; massage to aid absorption; graded active and passive exercises to stretch adhesions. The average case should show complete recovery after three to four weeks under this treatment. Continued subjective complaint beyond this period without definite objective signs (swelling, discoloration, muscle spasm) justifies the suspicion of hysteria or malingering.

Synovitis is most common in the knee. It seldom results from direct trauma, usually coming on after indirect violence such as a sudden twist which produces intrinsic damage. Synovitis is characterized by fluid in the joint, fluid that is usually mixed with blood. If the damage to the joint leaves some loose body or an unhealed tab the articulation may become unsteady and painful and tend to recurrent effusions.

Treatment. In the acute stage the same course may be followed as for sprain. If the effusion is marked immediate aspiration of the fluid is advisable, followed by the measures named. Motion should be begun early, about the fifth day. Too long splinting leads to atrophy and joint stiffness.

Joint cartilages may be damaged by the same injuries which cause sprains and synovitis. The damage is rarely due to direct violence; nearly always it follows a sudden twist or wrench of the partly bent knee. The internal semilunar cartilage is the one usually affected (about 20 times more frequently than the external). The damage is either a dislocation or fracture. The dislocation may lock the joint in partial flexion, necessitating reduction of the cartilage to permit voluntary extension of the leg. To bring about reduction it is necessary to widen the joint space and so unlock the cartilage. This can be accomplished in one of several ways: (1) Hyperflex the joint and press the cartilage back with the fingers. (2) Flex the joint, pull the leg down and have the patient kick the knee straight. (3) Have the patient sit on a table and swing the leg back and forth, often the cartilage slips back of itself. The associated synovitis is treated as described. Operation is best not considered unless recurrences take place.

Recurrent or chronic displacement is best treated by surgical removal. The best results are obtained if operation is done before joint changes take place. Recovery then takes six to twelve weeks. Operation after joint changes occur requires six to twelve months for complete recovery. If operation is not practical or is refused then treatment must consist of some form of support, as an elastic knee cap, or a knee

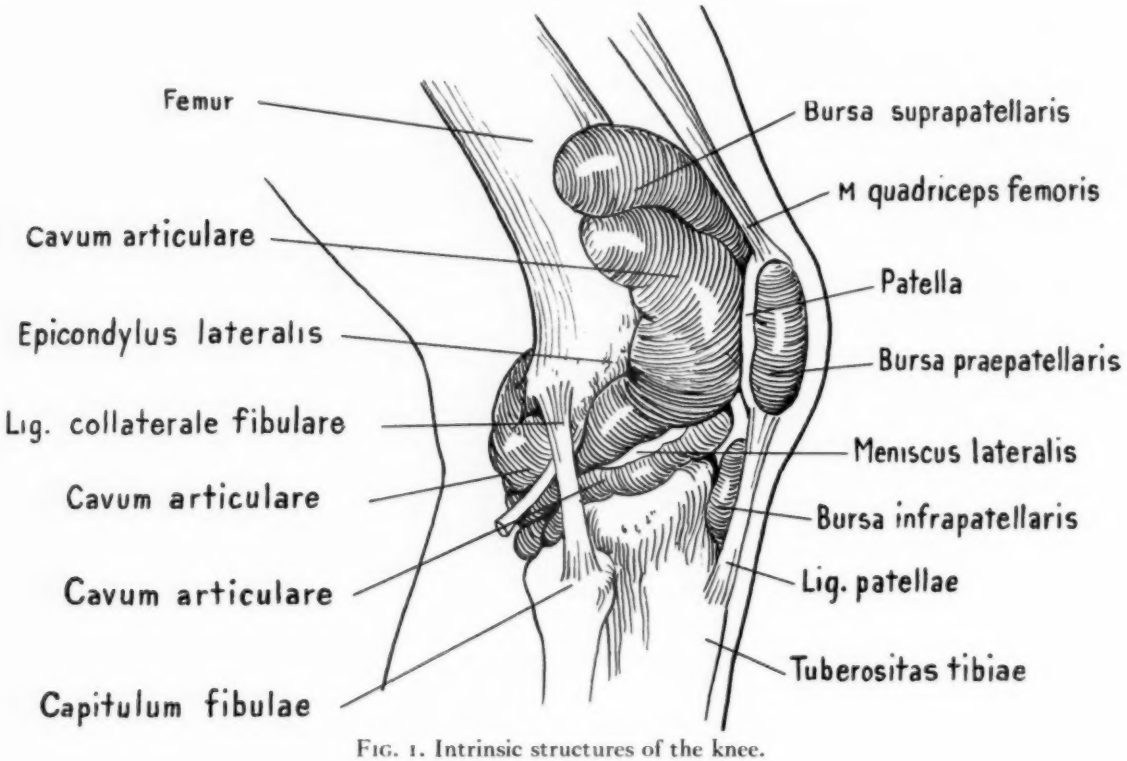

FIG. 1. Intrinsic structures of the knee.

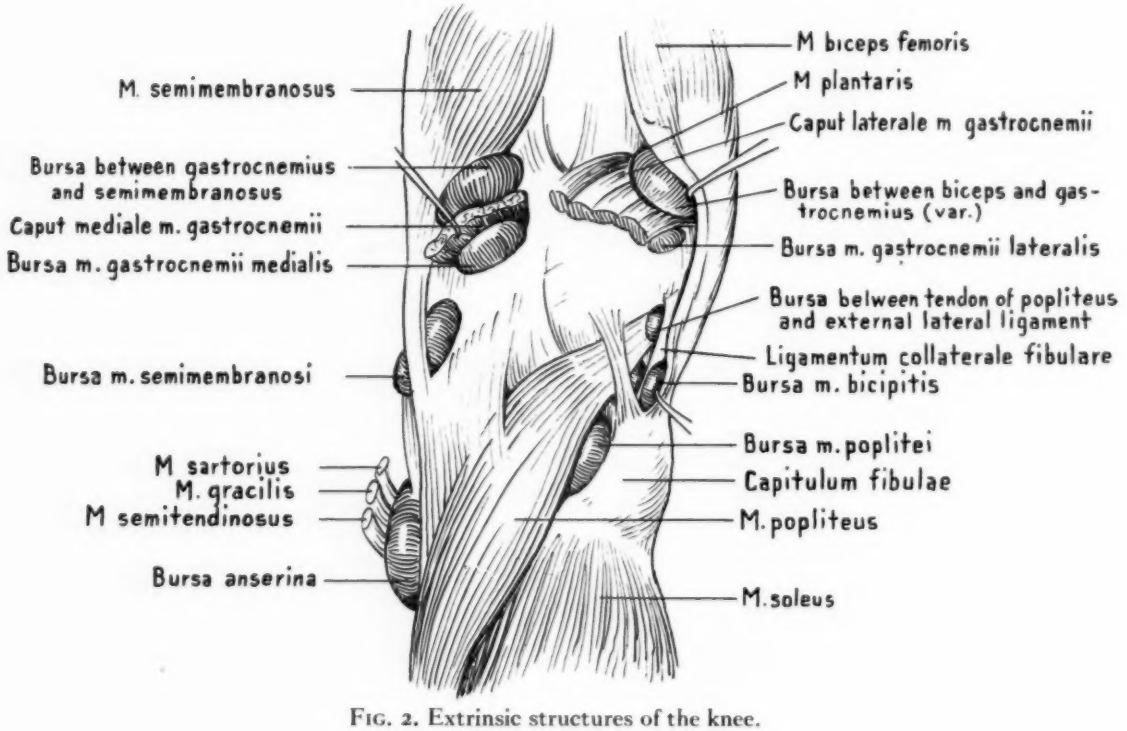

FIG. 2. Extrinsic structures of the knee.

brace, together with baking, massage and graded motion. The physiotherapy will help lessen the atrophy and weakness to the joint which usually accompany fixation of the joint.

Dislocation of the knee forward is the most common; next in frequency is backward and the rarest form is the lateral, either internal or external. Reduction is easy in recent cases. Traction alone or with manipulation (extension, flexion) is usually effective. The associated synovitis is treated as described.

Dislocation of the Patella. The outward form is the most usual; the inward form is rare. Replacement is usually not difficult. Reduction is made by pressure with the leg in extension. The synovitis is treated as outlined. A posterior splint is applied. Massage is begun at once and motion after several days. Walking may be allowed at the end of a week. Repeated dislocations require surgical intervention.

Stiff joint may follow as a direct result of injuries in and about the knee, or it may follow secondarily as a result of injuries to the limb distant to the knee, especially fractures of the femur. In the latter the stiffness results from weakness of the muscles controlling the joint and adhesions in the ligaments and tendons about the joint from lack of use. Stiffness is also produced by fixation of muscle to the bone at the site of the fracture. To restore function attention is directed to (1) increase of local circulation by application of heat, massage and hydrotherapy; (2) breaking up of adhesions by resistance exercises, careful and graded manipulation.

DISABILITY

If *stiffness* prevents full extension of the knee the joint is always somewhat unstable because the final locking movement in extension cannot be obtained. Disability will depend on the nature of occupation and the degree of restriction. With complete extension and flexion to 60 degrees walking should be normal and the injured should be fit for most heavy work not requiring kneeling. Any degree of stiffness disables one from being an acrobat or professional dancer.

Ankylosis most commonly results from fractures into the joint. The optimum position for bony ankylosis is with the leg flexed about 3 degrees. For fibrous ankylosis the optimum position is with the knee fully extended. This puts the least strain on the fibrous tissue in the joint. Ankylosis incapacitates the patient for most laboring work but does not unfit him for bench work.

Instability of the knee is more disabling than stiffness. It results mainly from weakness of the vastus internus from disuse. In part it is due to laxity of the joint produced by traction during treatment of fracture, resulting in stretching of the ligaments of the joint. Wearing a tight bandage about the knee increases wasting of the muscles. An unstable joint unfits the worker for ladder climbing and working at a height.

The *measure of disability* cannot be gauged by the amount of creaking on movement. Disability must be estimated from the degree of pain, restriction in movement and instability of the joint. These depend on structural changes resulting from the injury.

SUMMARY

1. The importance of the knee is stressed as a functional, industrial and social asset. Treatment must be directed to the preservation of these qualities.

2. Injuries to the knee which can be safely and effectively treated in the office are enumerated and their care described.

3. Various disabilities are noted and their permanent effects stated. Their evaluation must be based on objective findings.

TREATMENT OF HALLUX VALGUS (BUNION)

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THE term bunion has clouded the average physician's conception of the pathological alterations underlying a common but complicated deformity of the foot. The name connotes an inflamed bursa and a bony exostosis as the chief pathological changes.

The bony exostosis and the inflamed bursa are but complications of what may be more aptly termed the "hallux valgus syndrome." The first metatarsal bone is deflected mesially and is rotated in its longitudinal axis, the phalanges are deflected outward and rotated, and the sesamoids are displaced laterally into the intermetatarsal space. The deformity, once established, is maintained and accentuated by muscular imbalance. The constant friction and the repeated traumata of walking, concentrated on the inner aspect of the metatarsal head, which is thus rendered prominent, result in increased activity of the pericsteum with consequent bony overgrowth. The bursa lying between the skin and this exostosis, because of repeated subjection to these same trauma, becomes the seat of an inflammatory reaction.

Since mesial deflection of the first metatarsal is the notable deformity in each instance of hallux valgus syndrome, the cause of this change must be determined and the removal of this cause must be the first step in treatment. This deflection of the first metatarsal may be the result of splay foot, it may be a congenital condition, metatarsus varus primus, or it may be due to the presence of an os intermetatarseum, the latter two being relatively infrequent.

In splay foot there is a spreading of the foot in the region of the metatarsal heads, chiefly between the first and second metatarsals. This spreading is permitted by the weakened transverse metatarsal ligament which is attached to the plantar aspects of all of the metatarsal heads and is adherent to the capsular ligaments of all of the metatarsophalangeal joints. Splaying of the foot, one important element of which is mesial deflection of the first metatarsal bone, may appear in a congenitally relaxed foot; but even in a normal foot it will arise when the foot is held constantly in the pronated position during locomotion.

Certain strains, chiefly those centering about the anterior portion of the foot, are accentuated when the foot is pronated during locomotion. Strain on the forefoot is normally greatest during the rise for the take-off in walking because the entire body weight during this phase is dissipated to the ground through the metatarsals as they are rising to a vertical position. The metatarsal heads, encased in a tightly fitting, smooth stocking that rides on the frictionless leather insole of the shoe, slide forward and laterally. When the body weight is raised over a normally inverted foot, with the line of the metatarsal heads perpendicular to the line of progression, the spreading forces acting on the intermetatarsal ligaments are at a minimum. When the foot is in the pronated position, these spreading forces on the first metatarsal head are greatly increased and a considerable stretching force is thus applied to the plantar ligament connecting the first and second metatarsal heads (Fig. 1). Lake[1] has emphasized the role of the high heel in increasing this tendency toward splaying through its action in increasing the proportionate body weight applied to the anterior region of the foot (Fig. 2). The high heel undoubtedly accounts in great part for the greater frequency of bunion among women.

Congenital varus of the first metatarsal, generally referred to as metatarsus varus primus, is usually considered as an atavistic reversion to a separated and opposing first digit that can be used for prehension, similarly to the human thumb. In this condition the metatarsal face of the first cuneiform bone is inclined toward the medial side of the foot to an increased angle, much as in the foot of the ape.[2-4]

The os intermetatarseum is an infrequently encountered supernumerary bone situated between the bases of the first and second metatarsals. It acts as a wedge between these bones, causing a mesial deflection of the first metatarsal.

The first step in constructing an accurate interpretation of the deformity is a determination of the element or elements responsible for the metatarsal varus, that is, one or more of the three foregoing. The forces producing phalangeal valgus and metatarsophalangeal rotation may then be considered. Inflammation of the metatarsal bursa and the exostosis on the metatarsal should be viewed as complications of these primary deformities. Proper treatment can follow no other conception.

Valgus of the phalanges is the result of increased pull of the small adductor muscles under tension, of misdirected pull of the displaced extensor and flexor hallucis longus tendons, and of stretching and loss of function of the small abductor hallucis (Fig. 1). There is no muscular attachment to the first metatarsal head. It is these muscles that prevent the toe from following the metatarsal in its mesial deflection in hallux valgus syndrome. As metatarsal deflection increases, the phalangeal base is pulled laterally on the convex metatarsal head by these small muscles and is finally deflected outward (Fig. 3). This outward deflection of the phalanx may be accentuated by short and improperly designed shoes.

The tendon of the flexor hallucis longus passing across the plantar aspect of the metatarsophalangeal joint, in a groove between the sesamoids, and the tendon of the extensor hallucis longus passing over the top of the joint both have a slight natural tendency to pull the toe outward.

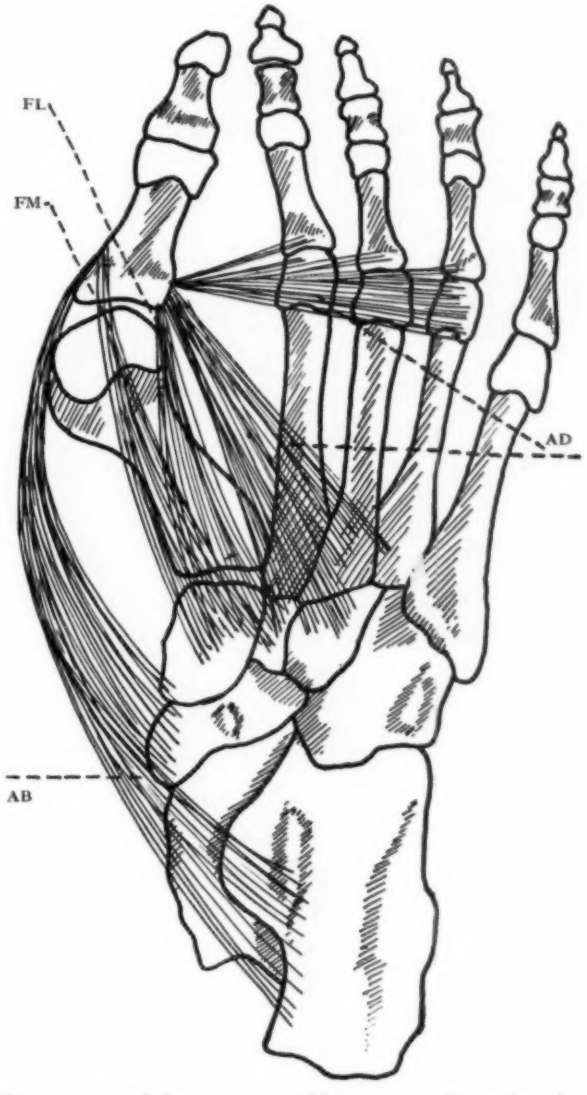

Fig. 1. AB, abductor; AD, adductor; FL, flexor brevis (lat.); FM, flexor brevis (med.). The small muscles on the plantar surface of the foot that are of importance in hallux valgus. Note that no muscle is attached to the first metatarsal head.

Once the valgus deformity has set in, the pull of these tendons is an important factor in increasing it.

Rotation of the first metatarsal and rotation of the phalanges so that the nail faces medially (Fig. 4) are produced by the same forces. After metatarsal varus and phalangeal valgus have become pronounced, the abductor hallucis and the medial head of

the flexor hallucis brevis are on a stretch. The lateral head of the flexor hallucis brevis is not. The medial head, attached to the medial side of the base of the phalanx, pulls the inner side of the phalanx plantarward, thereby causing the nail to face inwardly. Probably of more importance as a factor in rotation is the location of the transverse intermetatarsal ligament on the plantar aspect of the metatarsal heads. This restrains the plantar portions of the metatarsals to a greater extent than the dorsal portions in the spreading of splay foot. The result is a tendency for the first metatarsal to roll inwardly and the fifth metatarsal to roll outwardly. With angulation at the metatarsophalangeal joint the sesamoids are carried laterally with the tendon of the flexor hallucis longus. The movement of the sesamoids to the lateral side of the metatarsal head helps to produce rotation of this bone. As Graham[5] has pointed out, the very important function of the peroneus longus in holding the first metatarsal to the ground, and thus stabilizing it, is lost in the pronated foot, and diminished function of this muscle leads to inward angulation and rotation of the metatarsal.

The following is a résumè of the changes described and may be used in establishing an accurate diagnosis upon which treatment is based.

1. Metatarsal Varus
   a. Splay foot
   b. Metatarsus varus primus
   c. Os intermetatarseum
2. Phalangeal Valgus
   a. Abnormal pull of adductor muscles
   b. Displacement of flexor hallucis longus and extensor hallucis longus
   c. Stretched and atrophic abductor hallucis
3. Rotation of Phalanges
   a. Abnormal pull of medial head of flexor hallucis brevis
   b. Plantar resistance of transverse intermetatarsal ligament
4. Rotation of Metatarsal
   a. Lateral displacement of sesamoids
   b. Loss of peroneus longus function
   c. Plantar resistance of transverse intermetatarsal ligament
5. Exostosis of Metatarsal Head
6. Inflamed Bursa

Treatment is directed toward correction of metatarsal varus, correction of phalangeal valgus and rotation and eradication of the complicating inflamed bursa and bony exostosis. The therapeutic measures employed in correcting metatarsal varus will depend upon the underlying causative factor as outlined. Measures attacking the actual hallux valgus syndrome will vary with the degree to which the syndrome has progressed. Each case must be treated individually.

TREATMENT OF SPLAY FOOT

Unfortunately the splay foot observed in connection with hallux valgus deformity is usually of long standing. The indifference displayed by the profession toward cases of hallux valgus that have not progressed to the stage of incapacitating distress and unsightly deformity has forced patients to the door of the chiropodist for palliative padding and splinting. In the far advanced cases painful callouses are present beneath the anterior metatarsal region and indicate a completely flattened forefoot; muscle spasm, periosteal thickening and periarticular adhesions have produced a rigid or semirigid foot as Nature's attempt to immobilize an irritated section of the body.

In these advanced cases preliminary manipulative treatment without anesthesia at frequent intervals, preferably daily, must be carried out until active and passive motion in the joints has improved to such an extent that the foot can be forced into an approximately normal position. Each joint in the foot is moved to the limit of comfort in each direction. Manipulation once weekly with the patient anesthetized may supplement the daily manipulation. Great care must be exercised when manipu-

lating the foot of the anesthetized patient as harm may result from injudicious stretching.

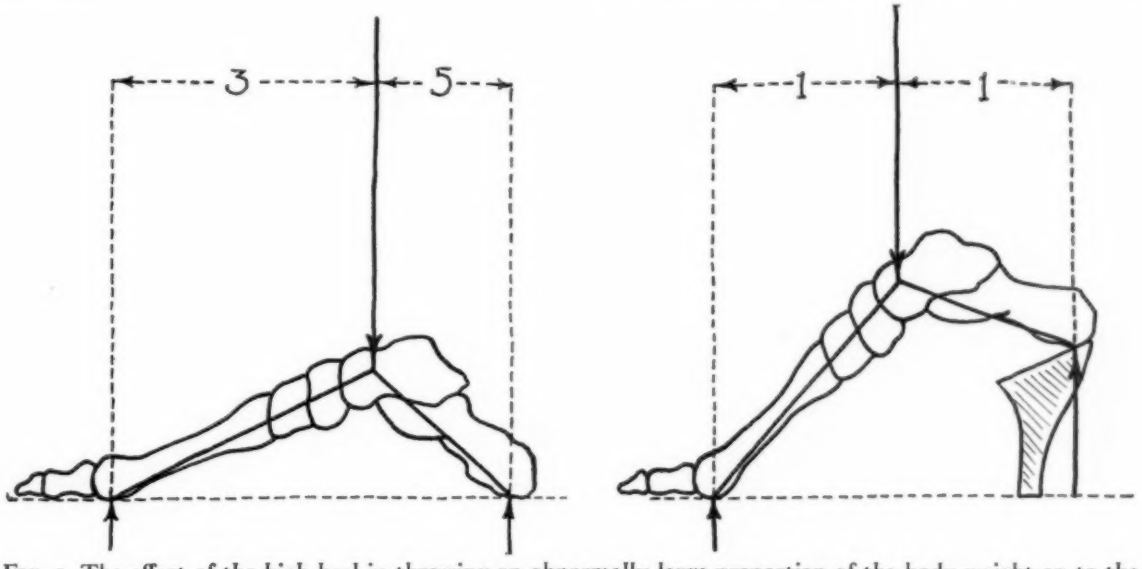

Fig. 2. The effect of the high heel in throwing an abnormally large proportion of the body weight on to the anterior portion of the foot.

When the foot can be maneuvered into a fair position without discomfort, a readjustment of weight distribution on the feet is begun. In effecting weight readjustment the outline for the treatment of the weak foot as recommended by Graham[5] is of great benefit because of its systematic attack and its practicality. This routine emphasizes re-education of pelvic, leg and foot posture. The proper degree of pelvic inclination is impressed upon the patient by means of a "wall maneuver" in which the small of the back approximates a wall when the head, shoulders, buttocks and heels are touching the wall. External astragalar rotation on the calcaneus is attained by twisting the leg outwardly on the foot. The action of the peroneus longus in stabilizing the first metatarsal pillar of the foot is developed in the "chair maneuver." In this exercise the patient, after fully adducting the foot while sitting on a chair, alternately raises the first metatarsal head and pushes it toward the floor.

A snugly fitting, circular, elastic band 2 to 3 inches in width applied just behind the first metatarsal head is of great benefit in compressing the anterior portion of the foot. This should be supplemented by a combined longitudinal and anterior support that extends well up under the necks of the second, third and fourth metatarsal bones. Firm harness felt makes the best material for the support. The first thickness used should be about 3/8 of an inch. This is then gradually elevated. The medial side of the fore part of the shoe should be straight and the heel should not be more than one inch in height.

Treatment of Metatarsus Varus Primus

This is corrected by a wedge excision of the first metatarsal base and the anterior extremity of the first cuneiform to produce ankylosis of the first cuneiformometatarsal joint in the corrected position of adduction and plantarflexion.

A 2 inch incision is made on the dorsal aspect of the foot on a line between the first and second cuneiforms and centering at the first cuneiformometatarsal joint. The extensor longus is retracted and the location of the dorsalis pedis artery is noted so that it may be preserved. The periosteum is lifted from the metatarsal base and from the cuneiform close to the joint. Small wedges with 3 to 5 mm. bases facing laterally are removed (Fig. 5). Whatever por-

tion of the joint surface then remains is excised. It is necessary to carry the base of the wedge plantarward so that the joint

Fig. 3. Reproduction of a roentgenogram illustrating metatarsal varus, lateral displacement of the sesamoids into the first interosseous space and lateral displacement of the first phalanx on the head of the metatarsal.

may be fused in plantarflexion. Occasionally it is advisable to chisel down a prominent lateral tuberosity of the metatarsal base. When enough bone has been removed to allow approximation of the first metatarsal to the second, the joint capsule and the dorsal tarsometatarsal ligaments are sutured and the skin is closed. The metatarsal is held in the corrected adducted and plantarflexed position by adhesive wrapped tightly over heavy felt pads that are cut to fit the plantar surface of the foot. Weight bearing is allowed in four weeks, but the patient must wear a molded steel support beneath the metatarsal six to eight weeks longer. Passive motion at the metatarsophalangeal joint is instituted at the end of one week.

Fig. 4. Sketch of a bunion showing the inward rotation of the phalanges with the nail facing medially.

TREATMENT OF OS INTERMETATARSEUM

This bone may be removed through an incision similar to that used in correcting metatarsus varus primus. The bone, of variable size, is situated between the first and second metatarsal bases. The proximity of the dorsalis pedis and its deep plantar ramus passing through the interspace to the plantar arch must be kept in mind since ligation of these vessels adds to the total amount of suture material left in the wound. The bone is best grasped and held with a sharp clamp, such as the ordinary towel clamp. After the bone has been removed, the operator must make certain that the metatarsal can be adducted and plantarflexed into the natural position. When a normal position cannot be accomplished after removal of the bone, a portion of the lateral tuberosity of the first metatarsal base may be pared down with a chisel. Motion should be started within a day or two in these cases.

TREATMENT OF HALLUX VALGUS

Correction of the hallux valgus deformity, that is, phalangeal valgus with metatarsal and phalangeal rotation, if of comparatively mild degree, may be delayed for some time after correction of metatarsal varus, whether this was due to splay foot, metatarsus varus primus, or os intermetatarseum. In the early cases the toe deformity can be improved by anterior metatarsal elevation, a toe post and a splint applied over the medial aspect of the big toe at night. The anterior elevation of the combined anterior and longitudinal support should start at the inner side of the foot just in back of the first metatarsal head. It is extended in a curve around the metatarsal head to make a sweep forward behind the heads of the second, third and fourth metatarsal heads and then back again medial to the head of the fifth metatarsal. The ideal supporting material is harness felt because of its slight resiliency. If a leather envelope is made to fit the insole of the shoe the felt elevation can be increased very gradually and with a minimum of discomfort. When a painful callus is present beneath the second or third metatarsal neck, sponge rubber may be substituted for harness felt. As tenderness in the callus diminishes this may be exchanged for felt. The circular elastic band is an important adjunct to the metatarsal elevation.

The metal toe post molded to fit the individual foot and fastened to a shoe insole is the ideal apparatus for forcing the big toe into a varus position. However, the technical difficulty encountered in procuring an exact fit is great and because of this the stationary toe post is not recommended for general use. A piece of heavy rubber tubing placed end up between the first and second toes works admirably. The tubing is at first compressed between the toes but a separation is slowly accomplished by stuffing the tube with cotton in gradually increasing amounts.

The big toe may be splinted in the varus position at night by tying a padded tongue depressor to the medial side of the foot and fastening it around the big toe and around the instep, the strap over the instep extending up over the ankle. Most of the manufactured bunion splints on the market are suitable.

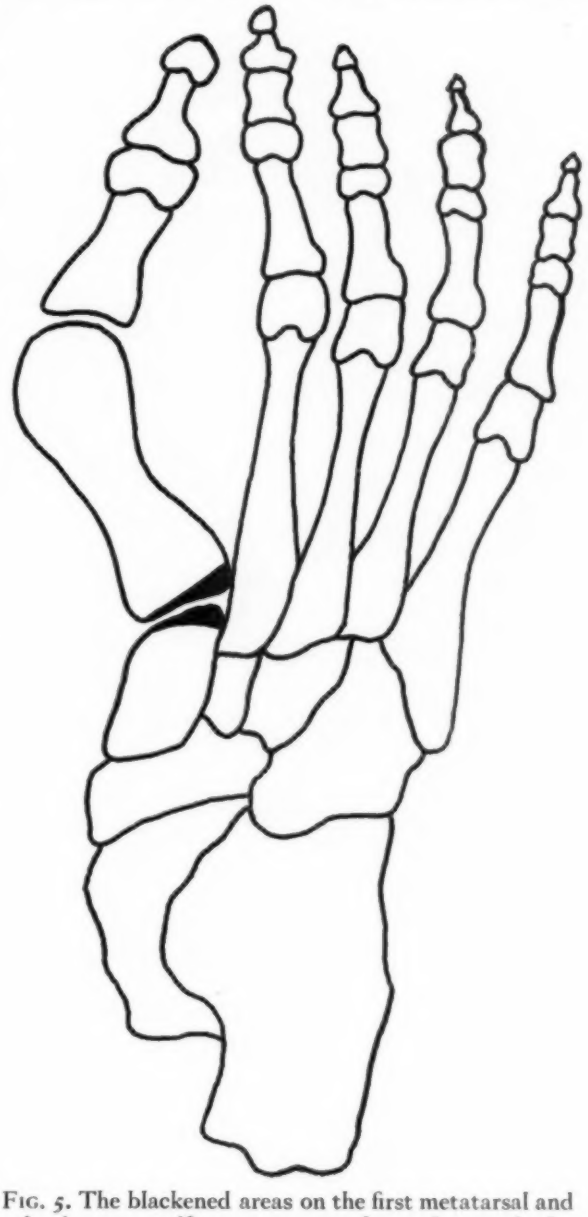

Fig. 5. The blackened areas on the first metatarsal and the inner cuneiform represent the wedges excised.

The marked hallux valgus deformity of long standing cannot be corrected by the measures that have been described and operative correction must be used. If the deformity is due to metatarsus varus primus or os intermetatarseum, the operations on the tarsus and the toes should be

done at the same time. While there is no routine operation for correction of the toe deformity, the procedure advocated by McBride[6] may be used as a basic operation to be varied to fit the pathological changes of the particular case.

A 2½ inch incision is made on the dorsum of the foot beginning in the web between the first and second toes and extending backward to expose the lateral aspect of the metatarsophalangeal joint. Keeping close to the bone, the attachment of the adductor hallucis to the base of the proximal phalanx is exposed. This attachment is severed and is held taut with a chromic suture. The lateral sesamoid is removed from the substance of the lateral head of the flexor hallucis brevis. The adductor tendon held by chromic suture is now attached to the periosteal covering of the lateral aspect of the first metatarsal head.

TREATMENT OF COMPLICATIONS (BUNION)

The patient suffering from hallux valgus syndrome ordinarily consults the surgeon for treatment when the metatarsal bursa is acutely inflamed. The pain caused by this inflamed bursa forces the patient to seek aid for a condition that has been no more than annoying for many years. Obviously, the first treatment must be directed toward relieving the acute inflamatory process. This will clear rapidly if the patient stays off his feet and keeps the painful member elevated. Hot compresses may hasten repair. No treatment in the form of manipulations, orthopedic apparatus or operation should be instituted until the acute inflammatory reaction in the bursa has subsided.

Operation is the only avenue for restoring the medial surface of the metatarsophalangeal joint to comfort after a bony exostosis has appeared and inflammatory changes have occurred in the bursa. Removal of the bursa and the exostosis should follow the suggested plastic procedure for hallux valgus deformity. By retracting the medial flap of the incision, the bursa and the bony exostosis can be reached. The bursa is removed and the indurated tissue surrounding it and adhering to the joint capsule and the tendons of the short flexor and the adductor muscles is excised. The bony prominence on the medial surface of the first metatarsal is chiselled down until the remodelled metatarsal head resembles what might be considered a normal structure. The toe is now placed in a line with the metatarsal and the capsule with the adherent tendon of the abductor hallucis is shortened. The medial head of the flexor hallucis brevis is tenotomized. The skin is closed with a non-absorbable suture and the fore part of the foot is held in place by firm adhesive strapping or by plaster casts, particular care being taken to compress the metatarsal heads and to elevate the second, third and fourth metatarsal necks. Passive motion is started on the second day after operation.

SUMMARY

Bunion, consisting of an exostosis of the first metatarsal head and an inflamed bursa, is presented as a complication of the pathological complex, hallux valgus.

Hallux valgus is, in turn, demonstrated to result from inward deflection, or varus, of the first metatarsal. This latter condition, metatarsal varus, may arise in any one of several different ways. It may be the result of splay foot, it may be a congenital condition (metatarsus varus primus), or it may be due to the presence of an os intermetatarseum. The mechanism of production is described in each instance.

Treatment is presented in detail under three headings: eradication of the bunion per se; correction of hallux valgus; and correction of metatarsal varus, either operative or non-operative.

REFERENCES

1. Lake, N. C. The Foot, Baltimore, William Wood and Company, 1935.
2. Truslow, W. Metatarsus varus primus. *Jour. Bone and Joint Surg.*, 7: 98, 1925.
3. Hiss, J. M. Hallux valgus. *Am. Jour. Surg.*, 11: 51, 1931.
4. Lapidus, P. W. Operative correction of metatarsus varus primus. *Surg. Gynec. and Obst.*, 58: 183, 1934.
5. Graham, James. Weak feet; pathogenesis and treatment. *Am. Jour. Surg.*, 35: 486–508 (March) 1937.
6. McBride, E. D. Conservative operation for bunions. *J. A. M. A.*, 105: 1164, 1935.

TREATMENT OF CONGENITAL TALIPES EQUINOVARUS (CLUBFOOT)

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PRACTICALLY all clubfeet can be completely corrected if proper treatment is begun immediately after birth. Good results, without recurrences, are based upon a gradual reduction of the deformity through a systematic series of manipulations and a period of complete or partial immobilization extending approximately to the weight bearing age, eight months.

Correct manipulation is impossible without an adequate conception of the deformity, which is a contracture of the foot at the extremes of motion in several directions. The several elements of the deformity are readily comprehended upon analysis of normal foot motion, an analysis which is conveniently made on the skeleton of the adult.

The astragalus, fitting in a three sided mortise, may rotate in a vertical plane so that its anterior end may be raised or lowered (Fig. 1). When the anterior end is lowered to the extreme, plantarflexion, the bone may move slightly from side to side, because the posterior half of the articulating surface is narrower than the anterior half, and the posterior half consequently fits the tibiofibular mortise less snugly.

The subastragalar joint between the calcaneus and the astragalus is composed of two parts, anteromedial and posterior (Fig. 2). Philip Wiles[1] resolves movement in this joint into four components: (1) in movement about a vertical axis the anterior end of the calcaneus moves inward or outward below the head of the astragalus (Figs. 4 and 5); (2) in movement about an anteroposterior axis the calcaneus tilts to one side or the other; (3) in movement about a lateral horizontal axis there is vertical raising or lowering of the head of the calcaneus; (4) in anteroposterior movement there is advancement or retardment of the calcaneus (Fig. 3).

The astragaloscaphoid joint is of the ball and socket type and is enclosed by a very loose capsule. Motion through the joint may be in a horizontal plane, side to side, a vertical plane, up and down, or it may be rotary (twisting).

Only very slight motion is possible in the midtarsus, made up of the cuneiforms, the scaphoid, the cuboid, and the metatarsal bases, because of the complicated interlocking of these bones (Fig. 7). The first metatarsal is an exception. The midtarsus articulates with the calcaneus through the calcaneocuboid joint. In this joint in the infant there is a fair degree of both horizontal and vertical motion, but this is lost in later years.

EQUINUS

There are two elements to the equinus deformity, both in the same direction (Fig. 6). The back foot, consisting of the astragalus and the calcaneus, is plantarflexed and this position is maintained by the contracted Achilles tendon and by the narrowing of the tibiofibular mortise which is the result of compression of this mortise over the narrower posterior half of the astragalar articulating surface. The wider anterior half of the astragalus, as McGregor[2] puts it, "forfeits its right of domicile" in the three sided tibiofibular box. Plantarflexion of the astragalus and the calcaneus is commonly referred to as "back foot equinus" or "ankle equinus." The back end of the calcaneus is drawn upward, and the whole bone is pulled back, that is, retarded, for about half the length of the astragalus.

The forefoot, in addition to following the back foot into plantarflexion, is further flexed through the midtarsal joints, the foot remain on the ground, the motion being purely horizontal. The scaphoid is moved inward on the head of the astragalus

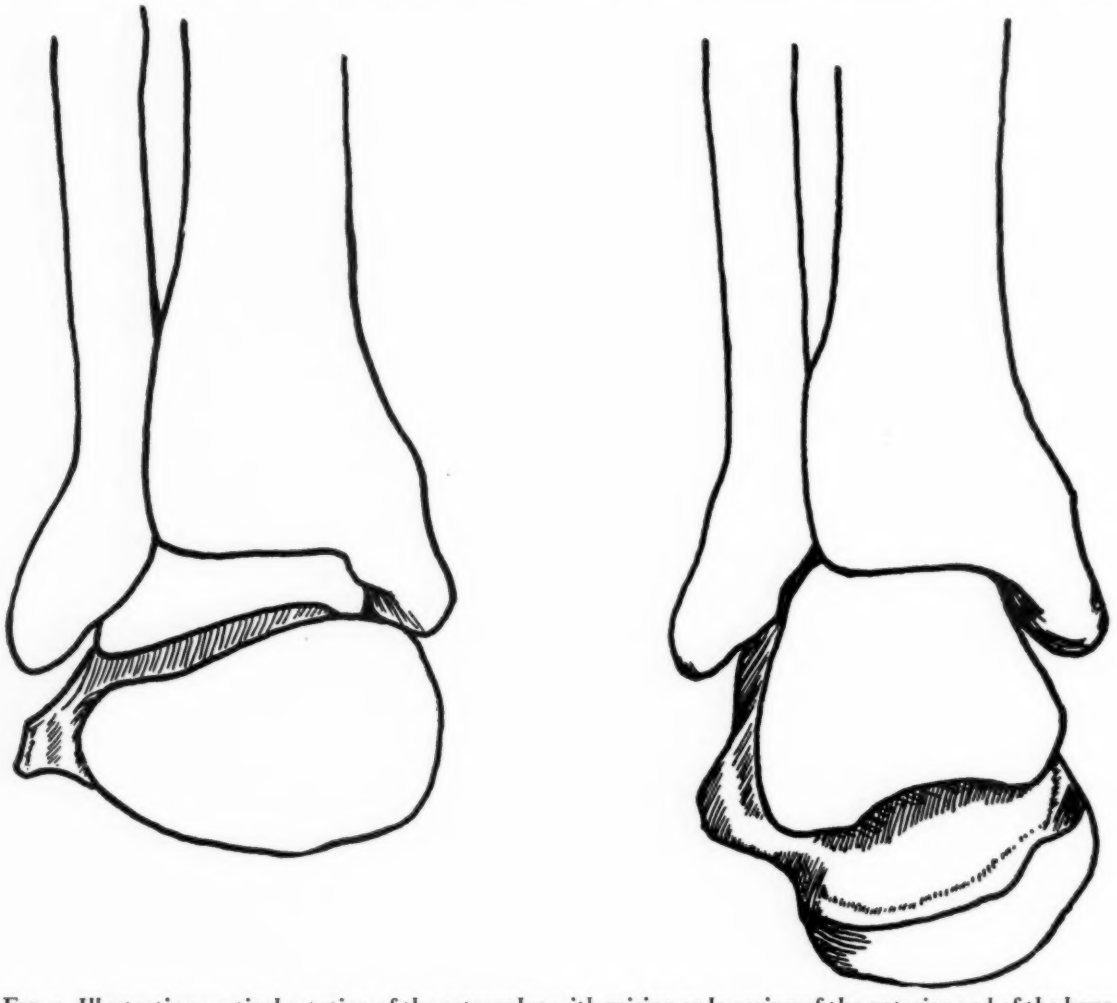


Fig. 1. Illustrating vertical rotation of the astragalus with raising or lowering of the anterior end of the bone. Note that the anterior half of the astragalar articulating surface is wider than the posterior half and that the bone consequently fits into the tibiofibular mortise more snugly when the anterior end is raised, that is, when the foot is in the horizontal position or is dorsally flexed.

astragaloscaphoid and calcaneocuboid, into what Brockman[3] has termed "talipes plantaris."

The equinus deformity, then, consists of plantarflexion of the foot in relation to the leg plus additional plantarflexion of the forefoot in relation to the back foot.

ADDUCTION-ABDUCTION

The forefoot is bent inward on a horizontal plane at the astragaloscaphoid and calcaneocuboid articulations (Fig. 8). In adduction both the inner and outer sides of and the cuboid is moved medially on the anterior articulating surface of the calcaneus. The calcaneus is abducted, that is, the anterior end of the calcaneus moves lateralward beneath the head of the astragalus. The astragalus tends toward adduction but does not completely follow the forefoot. The combined adduction of the forefoot and abduction of the calcaneus thus causes the foot to break at the calcaneocuboid joint so that the first toe and the back of the heel bend around inwardly to meet each other, as it were.

INVERSION

In inversion the inner side of the foot is elevated and the outer side is depressed there is inversion of both the calcaneus and the forefoot. The scaphoid is drawn inward and upward, in some instances far

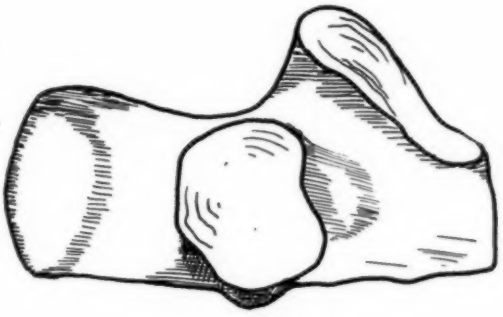
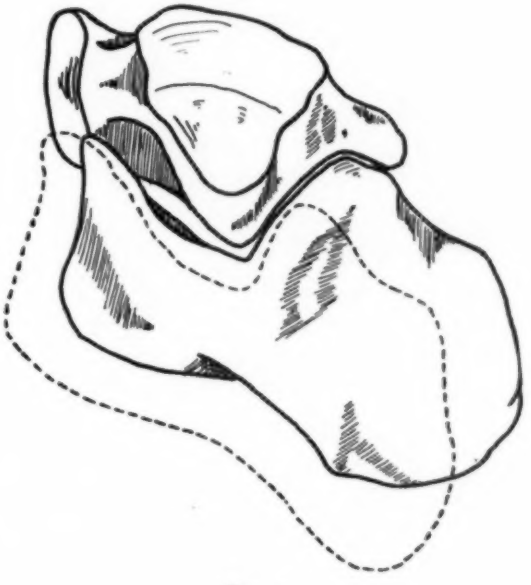


FIG. 2.



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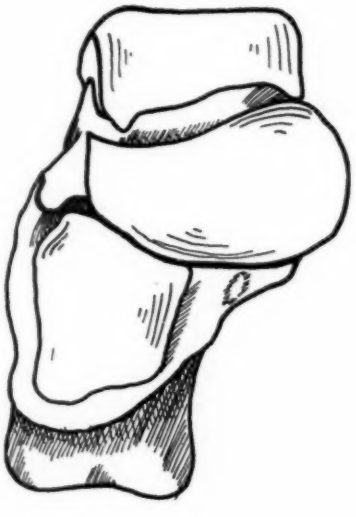

FIG. 4.

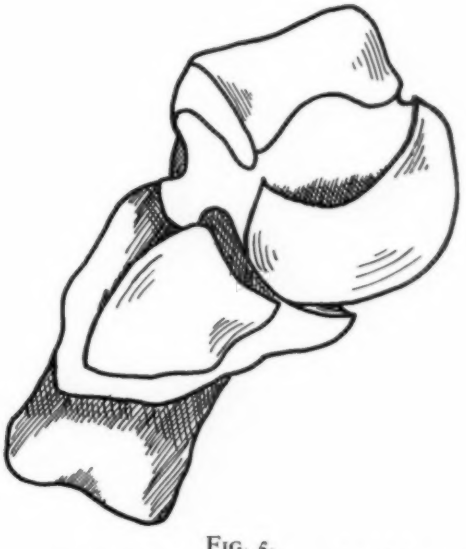

FIG. 5.

FIG. 2. The calcaneus, showing the anteromedial and the posterior articular surfaces into which the astragalus fits.

FIG. 3. Lateral view of the calcaneus and astragalus. The broken line represents the advanced position of the calcaneus.

FIGS. 4 and 5. The astragalus and calcaneus as viewed from the front after removal from the forefoot. Figure 4 represents approximately the normal relationship between the two bones. Figure 5 depicts tilting of the calcaneus (eversion), outward movement of the anterior end below the astragalar head (abduction) and vertical raising of the anterior end (dorsiflexion).

(Fig. 9). This movement takes place through the subastragalar and the astragaloscaphoid joints. In equinovarus enough to come into contact with the internal malleolus. The fifth metatarsal may be beneath or even medial to the first meta-

tarsal. The calcaneus twists on its longitudinal axis so that the inner side of the bone is elevated and the medial surface

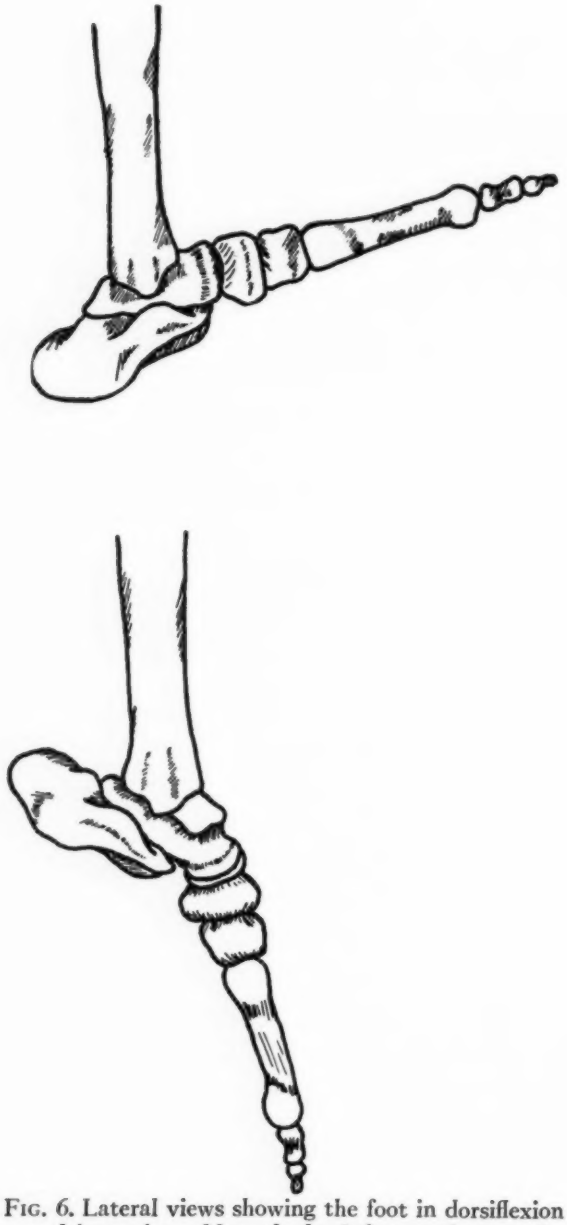

Fig. 6. Lateral views showing the foot in dorsiflexion and in equinus. Note the back foot equinus at the ankle, with the accompanying retardment of the calcaneus, and also the additional equinus of the forefoot on the back foot at the astragaloscaphoid joint. The bones are represented as completely developed, although the low arch of the infantile foot is retained.

moves up to the under surface of the astragalus. The degree of overlapping of the astragalar and calcaneal shadows on the anteroposterior roentgenogram is a valuable index to the degree of inversion of the back foot. Back foot inversion takes place through the subastragalar joint.

TREATMENT

The treatment of clubfeet must be carried out systematically, although a definite plan can be laid down only for the typical cases that are seen originally during the first few months of life. In the treatment of those cases of clubfoot that have been neglected, or in which inadequate measures have been applied, the routine must be varied to fit the individual condition. Ordinarily, in the early cases, full correction can be accomplished by non-operative measures, and during recent years there has been a decided, and indeed beneficial, tendency to employ operative procedures less frequently. Good results, however, from either non-operative or operative measures are dependent upon a thorough understanding of the deformity and upon a regular and systematic plan of attack directed against it. In some instances subcutaneous tenotomies are indicated in conjunction with posterior capsulotomy. Treatment should be started in the first week of life and a careful watch over the patient must be maintained for three years. The initial correction of the deformity cannot with safety be looked upon as a cure.

Beginning immediately after birth the foot is gradually brought into a position of correction and then overcorrection, this through a series of weekly manipulations and applications of plaster-of-Paris casts. The weekly manipulations entail a serial correction of each of the components of the distortion. While corrections of the individual components merge into a unified correction of the whole, the attack on each component is begun in a definite and logical sequence.

Each week, in the manner to be described, the foot is manipulated and is stretched, without an anesthetic, enough to gain improvement in the position of the cast. Manual stretching is carried out against the direction of each component,

the emphasis being placed on the various components in the order in which they have been attacked. Gentleness in the manipulations is imperative, since harm may result from rough handling. However, a definite gain must be made each week because the structures of the foot become more resistant with time. As long as the infant responds to stimulation of the skin of the foot and as long as the circulation appears to be adequate, correction is not being forced too rapidly.

Fig. 7. The normal foot as seen from above. The bones are represented as completely developed.

Until overcorrection has progressed to a fair degree of outward rotation and dorsiflexion, that is, calcaneovalgus, the plaster-of-Paris cast is the best form of retention brace. None of the frequently used methods employing lateral splints, metal plates with elastic bands, or adhesive plaster, holds the corrected heel position as well as the plaster cast. Apparently, many surgeons assume that inversion of the back foot is automatically corrected as the forefoot is pulled into eversion, but such is not the case, and adequate correction of back foot, or calcaneal, inversion, with maintenance of correction thereafter, demands as much effort as any of the other components.

Fig. 8. Illustrating adduction of the forefoot and abduction of the calcaneus through the midtarsal joints. Note the medial displacement of the scaphoid and cuboid.

The plaster cast in these young infants may be extremely light, several thicknesses of 2 inch plaster bandage being sufficient. It should be applied from within, down and out so that correction is held as the bandage is applied. The plaster is applied over a single layer of roller sheet wadding with an extra thickness over such pressure points as the malleoli and the heel. Small slips of

wadding are placed between the toes. The bandage extends from the tips of the toes to the tibial tubercle. As the plaster dries,

Fig. 9. Illustrating inversion. The rotation of the tibia and fibula is only apparent. The tibia is often inwardly rotated on the femur but this is important only in neglected cases.

manual molding of the cast is employed to insure a snug fit. That both the individual applying the plaster and the individual holding the foot in the corrected position during the application should have a thorough understanding of the deformity is an item frequently overlooked. It is certainly inconsistent to exert great care in manipulating and stretching a clubfoot and then to apply a plaster cast while the extremity is carelessly held by a nurse whose knowledge of the mechanism of clubfoot distortion is at best minimal. When the cast is removed at the end of a week, the leg should be cleansed with alcohol, dried and powdered.

Correction of the several components is begun in the following sequence: forefoot adduction, calcaneal abduction, forefoot inversion, calcaneal inversion, forefoot equinus, ankle equinus. The equinus element is left until the last because the taut Achilles tendon holds the heel in the back end of the tibiofibular mortise and thus affords a fixed point in the foot from which one may work in lining up the forefoot with the back foot. If an attempt is made to overcome the forefoot equinus before adduction has been corrected, the scaphoid, displaced medially on the head of the astragalus, will ride up on the inner side of this bone. The deformity will then recur some time later when weight bearing begins for the simple reason that body weight on the astragalus will be transmitted to the lateral side of the scaphoid when this latter bone is displaced medially, and thus it will be pushed inward, bringing the foot into adduction. In addition, equinus correction produces an improper pull on the calcaneus when this bone is still in the inverted position.

In the manipulation against *forefoot adduction*, the thenar eminence of the operator's hand is placed on the outer side of the infant's foot in such a manner as to cover the external malleolus and the calcaneocuboid joint. The fingers bend around the back of the heel. For manipulation of the infant's left foot, the operator's left hand holds the heel; and contrariwise for the right foot. The butt of the opposite hand is placed against the inner side of the first metatarsal. The two hands are then pushed in opposite directions until the structures on the inner side of the foot become tense. The stretching forces of the hands are slowly relaxed and resumed alternately for a period of several minutes. With each successive application of plaster, the inner border of the foot becomes less concave, then straight, and finally convex. It is to be noted that both forefoot adduction and *calcaneal abduction* are overcome by this one maneuver. When the inner border of the foot is convex, the adduction has been overcorrected.

Beginning with the initial cast application an attempt is made to derotate the *inversion components*, both forefoot and back foot. Manipulations to this end, however, should not be as forceful as those directed against adduction-abduction until the inner border of the foot is straight, for

until such a time, the scaphoid has not been returned to its proper central position on the astragalar head. This is usually a matter of several weeks. Forefoot inversion and eversion occur in the astragaloscaphoid joint, and forcing a rotary motion through this joint, by forcibly everting the foot, before the scaphoid is centralized, stretches the surrounding joint structures in an improper manner. The calcaneocuboid joint is likewise subjected to improper stress if eversion is forced before the cuboid has been pushed back, by abductory manipulation, to its proper position directly in front of the calcaneus.

It has been mentioned previously that manipulation against inversion is begun with the initial treatment, but that it is not done with full force until adduction, as judged by the contour of the inner border of the foot, has been corrected. In this maneuver the calcaneus and forefoot are considered as a unit, the underfoot, and this underfoot unit is rotated outward beneath the astragalus. The forefoot rotates through the astragaloscaphoid joint and the calcaneus through the subastragalar joint. Because of this movement of the underfoot through two joints, both sections of the underfoot, calcaneus and forefoot, must be grasped and moved simultaneously. If this is not done, improper stress is thrown on the calcaneocuboid joint.

It is of great importance that the internal and external malleolus are not injured during eversion of the underfoot. Careful and steady manipulation, without jerking, will prevent undue strain on the lower end of the tibia, while the external malleolus can be protected by grasping the foot properly. The ball of one thumb is placed on the external malleolus of the extremity to be manipulated and the ball of the other thumb is placed on the nail of the first thumb. The hands encircle the ankle, one in front and one in back, so that the fingers of one hand may grasp the first metatarsal and the fingers of the other hand may grasp the heel. The underfoot is then rotated outward. When the heel is straight below the tibia and when the plane of the metatarsal heads is perpendicular to the leg, inversion has been corrected. Slight overcorrection of the inversion is then made, but the extreme overcorrection of inversion that has so often been recommended should be avoided.

When the varus, consisting of adduction-abduction and inversion, has been slightly overcorrected, that is, when the inner border of the foot is convex, when the heel is straight and when the sole faces a shade outward, manipulations for the correction of equinus are begun.

It cannot be too strongly emphasized that there are two parts to *equinus*, plantarflexion of the foot on the leg and additional plantarflexion of the forefoot at the midtarsal region. Attention is directed first toward equinus of the forefoot. In this manipulative maneuver the hand of the operator that is opposite to the side of the infant to be stretched grasps the forefoot well back on the tarsus with the fingers on the sole of the foot. The heel and ankle are held from behind with the other hand. The forefoot is then gradually pulled up until it is in line with the back foot. Correction of back foot equinus is not begun until this has been accomplished. Overcorrection is to be guarded against, for it produces a rocker foot.

In correcting back foot equinus it is important to bear in mind constantly the several important features of this component. The astragalus is not displaced forward and therefore does not have to be "shoved back" into the tibiofibular mortise. The astragalus never leaves this mortise in equinovarus; it merely rotates in the mortise so that its anterior end is lowered. Its position is properly readjusted in the mortise by a rotary movement that elevates the anterior end, not by a backward thrust. The calcaneus in clubfoot is retarded in the subastragalar joint and its posterior end is elevated. Correction is accomplished by pulling the back end down and by pushing the bone forward.

The ankle is grasped from the inner side with both hands, one behind and one in front. The structures are then stretched by a rotary movement in the long axis of the body. This rotary movement is clockwise for the right foot and counter-clockwise for the left foot. The actual movement cannot be described clearly and it is carried out correctly only when the operator visualizes the astragalus rotating backward in the tibiofibular mortise, the back end of the heel coming down as the Achilles tendon is stretched and the body of the calcaneus slipping forward beneath the astragalus.

Progress against equinus is made with each weekly reapplication of plaster, although it is not as rapid as that during the correction of varus. When dorsiflexion has reached the stage in which the angle between the dorsum of the foot and the leg is fairly acute, particular care must be exercised in the application of plaster in the angle. If progress in correcting equinus is slow, that is, if good dorsiflexion has not been attained in three to five months, an anesthetic should be administered so that a more accurate estimate of the contracture may be made and a cautious manipulation carried out. This may be repeated within three or four weeks. In the usual case this is not necessary and full correction can be made without anesthesia or operation.

Manipulation with the aid of anesthesia must be employed with the greatest care. It should be entirely manual, never with block or wrench, and never with any crushing force. Kite[4] has pointed out that when feet are placed in plaster casts for some time, the bones become soft because of calcium absorption. Manipulation of such feet with undue force breaks the articular cartilage. Further immobilization after the manipulation results in ankylosis. If the desired improvement is not gained by cautiously increased manipulation with the aid of anesthesia, the operation described in a later paragraph becomes the procedure of choice.

A check-up roentgenographic study is made at this time. Lateral views are taken with the foot dorsiflexed as far as possible. If this shows equinovarus to be satisfactorily corrected, light retention braces replace the plaster-of-Paris casts and the follow-up course which will be outlined presently is begun. If the roentgenograms reveal persistent equinus, a more radical attack is indicated so that the infant may enter the standing and walking periods with at least approximately normal feet.

When the foot of a normal infant six months of age is fully dorsiflexed, the foot should make an angle of about 45 degrees on the roentgenogram, and the long axes of the calcaneus and the first metatarsal should form an approximately straight line. If there is plantarflexion at the midtarsus, forefoot equinus persists; if there is dorsiflexion at the midtarsus, forefoot equinus has been overcorrected and a rocker foot exists. If the calcaneus is not dorsiflexed to 45 degrees, back foot equinus persists.

In 1917 Zadek and Barnett[5] recommended a combined achillotomy and capsulotomy for those cases of equinovarus in which there was a resistant back foot equinus. This procedure was employed on infants over one year of age. In 1933 McCauley and Krida[6] reported the use of this procedure in infants of six months and younger. If the forefoot has been overcorrected with a resultant rocker foot, this must be brought down in line with the calcaneus and the foot immobilized in equinovalgus for a period of one to two months to gain midtarsal stability before the operation is undertaken.

A tenotome is inserted at the inner border of the Achilles tendon just above the calcaneus, and the tendon is divided. The tenotome is then inserted into the ankle joint and the posterolateral, posterior and posteromedial capsular structures are completely severed. Care is exercised to avoid the posterior tibial artery, by pushing the vessel against the skin with the back of the tenotome before the posteromedial aspect of the joint is entered. The flexor

hallucis longus tendon is included in this section. The foot is held by adhesive in as much dorsiflexion as is consistent with free circulation, and, as it is hardly necessary to comment, the foot must be closely watched for two or three days for signs of circulatory impairment. The overcorrected, dorsally flexed position is maintained for one to two months, the adhesive being removed at weekly intervals for manipulation.

Assuming that treatment of an infant with the usual type and degree of equinovarus has been instituted immediately after birth, full correction should be gained in from four to seven months, and this includes immobilization in the overcorrected position for a period of one to two months. It is worth noting again that overcorrection implies extreme overcorrection of equinus, but only slight overcorrection of varus. The close follow-up should extend to the end of the third year, at intervals of two to three months to the end of the second year and at quarterly intervals during the last year.

The normal infant bears weight on the feet at from eight to ten months and the average infant begins to walk unaided at from fourteen to sixteen months. Ideally, the infant who is born with equinovarus should have unimpeded use of the feet at the beginning of this period. For this reason, after the seventh month, the feet should be unbraced during the greater part of the day. If, however, there is any tendency toward varus or equinus, the elastic retention braces to be described should be worn during the day. During the night, either the elastic braces or molded plaster splints may be used. Any really definite tendency to recur must be regarded as the result of inadequate correction of the original equinovarus and the feet should again be subjected to a period of manipulation and immobilization.

Elastic braces are more suitable than immobile retention braces of plaster or aluminum because they permit foot and ankle motion, and, if properly adjusted, they assist the weaker dorsiflexors and pronators (Fig. 10). The continuous pull of the elastic ribbons tires out the stronger

Fig. 10.—Illustrating the application of elastic retention braces.

supinators and plantarflexors. These muscles and tendons are gradually stretched, and the muscles assisted by the ribbons are allowed to shorten. This method, originally known as the "American Plan" of elastic extension, but popularized by Barwell,[7] an Englishman, in 1863, was used extensively and with great satisfaction by David Prince,[8] as he reported in 1864. The ribbons are attached to the skin by adhesive plaster, as shown in the illustration. The artificial tension of the elastic ribbons complements the weakened muscles by acting upon the same bones and in the same directions. The points from which the pull arises should be close to the origins of the weakened muscles. Thus, in assisting the dorsi-

flexors and pronators in overcoming varus and equinus, the fastening is made on the anterolateral aspect of the upper part of the leg at a point over the origins of the peronei muscles. The lower attachment imitates the insertions of these muscles, passing beneath the fifth metatarsal base and the cuboid and fastening to the inner side and dorsum of the foot. This elastic technique has an advantage over that employing an aluminum sole plate, and recently advocated by Brown,[9] in that it does not interfere with foot action while assisting the weakened muscles. When these elastic ribbons are used, the infant enters the standing and walking period with full use of the feet.

Such elastic braces may be worn at night or they may be removed and replaced by molded plaster splints. The skin may be kept in much better condition if the adhesive is removed for the night so that the skin may be bathed with alcohol and given a chance to breathe during the sleeping hours. The plaster splints are held in place by a roller bandage.

The operative treatment of congenital clubfoot other than subcutaneous achillotomy and capsulotomy forms another chapter. In the ordinary cases that have received proper manipulation and immobilization, it is not necessary, and it should be reserved for the neglected and maltreated cases, for the more severe cases that are often accompanied by clubhands and for those associated with spina bifida, nerve and bony defects of the limbs.

SUMMARY

Practically all clubfeet can be completely corrected if proper treatment is begun immediately after birth. Good results, without recurrences, are based upon a gradual reduction of the deformity through a systematic series of manipulations and a period of complete or partial immobilization extending approximately to the weight bearing age, eight months.

The manipulative attack must be directed against each of the several components of the deformity if the foot is to be restored to normal. Each of these main components, equinus, adduction-abduction and inversion, must be corrected in both the forefoot and the back foot. In equinus the back foot is plantarflexed at the ankle joint and the forefoot is further plantarflexed on the back foot. In adduction-abduction the forefoot is adducted and the calcaneus is abducted. In inversion both the forefoot and the calcaneus are inverted.

Weekly manipulations proceed systematically toward a reduction of each of these component distortions and the gain made with each manipulation is maintained by a plaster-of-Paris cast. The manipulative maneuvers are explained in detail.

If good dorsiflexion has not been accomplished within five months the closed operation for achillotomy and posterior capsulotomy is indicated so that the infant may enter the weight bearing period with unhampered feet.

For the infants in whom the contracture shows a tendency toward recurrence, elastic extension braces are indicated. These are described.

REFERENCES

1. Wiles, Philip. Flat feet. *Lancet*, 2: 1089, 1934.
2. McGregor, A. Lee. Congenital clubfoot: an analysis of the deformity and the principles of its treatment. *Lancet*, 2: 20, 1933.
3. Brockman, E. P. Congenital Clubfoot, New York, William Wood and Company, 1930.
4. Kite, J. H. The treatment of congenital clubfeet. *Surg. Gynec. and Obst.*, 61: 190, 1935.
5. Zadek, Isadore and Barnett, E. L. The importance of the ligaments of the ankle in correction of congenital clubfoot. *J. A. M. A.*, 69: 1057, 1917.
6. McCauley, John C. and Krida, Arthur. The early treatment of equinus in congenital clubfoot. *Am. Jour. Surg.*, 22: 491, 1933.
7. Barwell, Richard. The Treatment of Clubfoot without the Division of Tendons, London, 1863 (quoted from Prince).
8. Prince, David. Orthopedic Surgery, Transactions, Illinois State Medical Society, 1864, p. 62.
9. Brown, Lloyd T. The treatment of clubfeet. *Jour. Bone and Joint Surg.*, 18: 173, 1936.

INGROWN TOE-NAIL*

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INGROWN toe-nail is a common condition where dirt, sweat and irritation meet and it is doubtful that the trimming of a toe-nail in any particular fashion is the causative agent. However, when tight shoes, perspiration, uncleanliness or friction unite and set up a local irritation of the skin allowing invasion of bacteria, a so-called ingrown toe-nail may result. In the first stage there is simple inflammation of the nail-wall with swelling and redness causing what appears to be an embedding of the lateral nail-edge. In the second stage this inflammatory condition continues to suppuration. In the third stage the suppuration of the nail-wall progresses and burrows under the nail-body and root.

It is with this second and third stage that I will specifically deal. In the second stage excision of a small wedge will probably cure the condition but recurrence is common. In the third stage excision of a wedge is rarely satisfactory unless part of the nail and growth matrix are also removed. This operation is unsatisfactory in the hands of many men; it leaves a deformed toe and nail which is unsightly, and frequently a small piece of growth matrix is left from which spicules of nail grow and cause constant irritation.

In 1932 a girl presented herself with an ingrown toe-nail that required radical surgery. Due to the fashion of going stockingless she refused excision of part of her nail-bed as she felt it would interfere with her appearance when she exposed her polished nails. In overcoming her objections I performed a slightly different type of operation which has been satisfactory in over 100 cases without recurrence.

Operation is done under local novocain and a rubber band at the base of the toe. The extent of the inflammatory condition

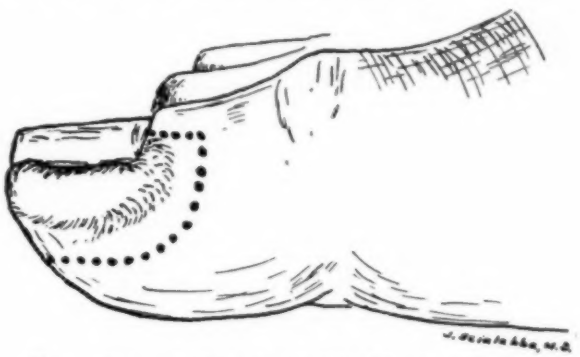

FIG. 1. Lateral view showing incision in nail-wall.

across the nail-root is taken into consideration and an incision ¼ inch long is made in the skin down to the nail-root at a point where the maximum swelling just ceases (Fig. 1). The incision is then carried laterally and downward to the level of the lower third of the side of the toe. It is then carried forward at this level to the end of the toe. The depth of this incision is about ¼ inch. A pointed scissors is then inserted under the free end of the nail at such a point as to meet the incision in the nail-bed and the nail cut. The cut portion of the nail is then grasped with a hemostat and lifted out of its bed. The nail-wall is then held back with a thumb forceps while the scalpel cuts down along the nail sulcus to the level of the incision in the lower third of the side of the toe (Fig. 2). If the incisions are properly placed a block of tissue is freed which lifts out except at the nail root where it must be freed being careful not to injure the growth matrix. Bleeding is rare. Before packing with iodoform gauze the rubber band is cut and all bleeding controlled. The packing is left

* From the Out Patient Service of the Norwegian Hospital.

in place for forty-eight hours and repeated for one week. When the slight sloughing has discontinued the wound is stimulated with balsam of Peru. Granulations form very rapidly and must be fought down constantly so that when the wound is completely healed this side of the toe is flat with no visible nail-wall (Fig. 3). I feel that the fighting down of the granulations is a very essential part of the operation. If not properly done the side wall will not be flat and there might be a possibility of recurrence in the new formed nail-wall. The nail grows back in four to six months and the aesthetic patient is most appreciative.

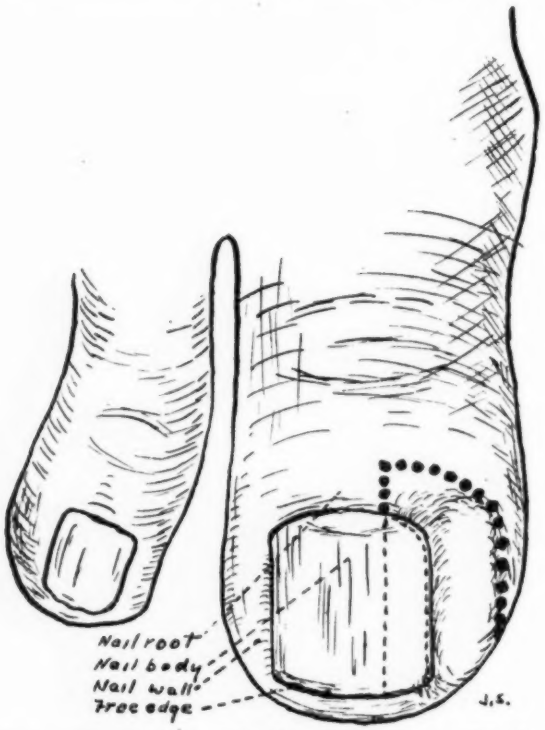

Fig. 2. Dorsal view showing incision in nail-bed and nail-wall.

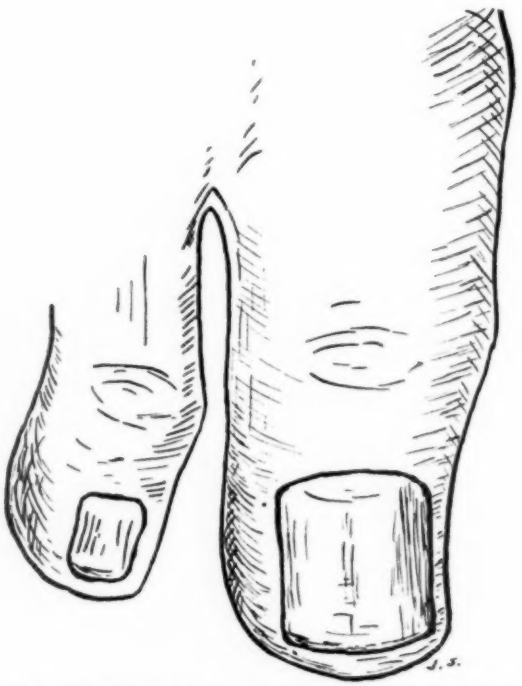

Fig. 3. End result showing flattening of nail-wall.

SUMMARY

A satisfactory operation for the cure of an ingrown toe-nail that can be performed by the average man with uniformly good result had been presented.

HAMMER-TOE AND CLAW FOOT

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IT would be difficult to find a more descriptive term than hammer-toe, for so it is, at least in shape. When several toes are involved, and if associated with an abnormally high arch, it is spoken of as claw foot.

More scientifically, if less picturesque, hammer-toe is a characteristic joint deformity (Fig. 1), in which the proximal phalanx is hyperextended at the metacarpophalangeal joint, acutely flexed at the proximal phalangeal joint, and either extended or flexed at the distal phalangeal joint. Not infrequently, the toe is dislocated upward at its junction with the metatarsus, with concomitant alterations in the joint capsule and ligaments. Even in the absence of luxation these changes are present and may be accompanied by arthritic or other osteoplastic changes in the epiphyses. All such changes in joint capsule, ligaments and epiphyses are secondary to the deformity and the deforming cause.

The peculiar shape of the toe in relation to the footwear often produces distressingly painful corns, callouses and thickened bursa on the knuckle of the proximal joint and at the tip, the latter including a deformed nail. Tender ulceration and callus, however, may appear at any point of constant pressure.

For such a common deformity, surprisingly little has appeared in the literature concerning the etiology; it is usually dismissed, in the average orthopedic text, with a few brief words on treatment. This obviously creates the impression that a routine therapy is available for all such toes, which is certainly not the truth, nor does such an impression convey the surprising individual variations which may occur, and do accompany, such deformities.

Hammer-toe may be congenital but this is undoubtedly rare. It often accompanies bunion (hallux valgus), in which case the second digit is usually involved. It is more frequent in the female, possibly because of the higher incidence of hallux valgus in this sex. One may find hammer-toe in what is essentially a "normal" foot, these cases usually involving the fifth and, in the majority of these, undoubtedly deformed by direct pressure of footwear.

In the past much stress was placed upon footwear as a deforming agent. While true that certain applied pressures are capable of causing almost any type of malformation (witness the bound feet of Chinese women), it is also probable that ill-fitting footwear of itself, in the absence of defective inheritance, balance, gait or weight distribution, would cause few serious deformities.

In certain instances of pes cavus or high arch, multiple hammer-toe occurs. These are essentially indistinguishable from other hammer-toes accompanying other deformities. The combination of pes cavus with hammer-toe has been given the name of claw foot, and perhaps unfortunately, because high arch is quite frequent without toe deformity. The term "claw foot" wrongly implies the same mechanism for both the distorted arch and the deformed toes.

The fact that hammer-toe occurs, independent of, or seemingly in spite of various other deformities but serves to emphasize its own peculiar etiology. Unfortunately, this latter has been confused and entangled with the etiology of flat-foot, hallux valgus, pes cavus, and certain other malformations when the association of these may be causal to a limited extent, but is not the fundamental disfiguring force.

The only clues obtainable from a study of accompanying deformities lead to negative evidence. A well deformed second hammer-toe accompanying hallux valgus or flat-foot presents the same anatomical picture as does a hammer-shaped fifth toe in an otherwise normal type foot, or three or four such toes accompanying pes cavus. One can assume from this that the hallux valgus, flat-foot, or pes cavus is not the cause, *per se*, of the toe deformity. But, on the other hand, it is difficult to say that these associated conditions are not in some way related to the toe deformity, since there is no reliable information available, taken from random sampling of "normal" and "abnormal" feet, to afford a means of correlation.

Fig. 1. The typical hammer-toes of a claw foot showing pressure points. This is the position of the toes as the foot bears weight.

It must be emphasized that in hammer-toe we are dealing primarily with a *joint deformity* and that bony and capsular changes are secondary. The forces which can alter the relationship of the bones meeting to form a joint are trauma, external pressure, paralysis of certain muscles, and inflammation with contracture or spasm. Traumatic hammer-toe is quite rare. External pressure is always a potent consideration and this seems to account particularly for the frequency of the fifth hammer-toe in the female utilizing certain modern footgear. Unfortunately, the same line of reasoning fails to account entirely for a second or multiple hammer-toe. These are often seen, with large painful corns and bursa, on both the tip of the toe and the dorsal surface of the proximal joint. It is blithely stated that these painful accompaniments are the result of pressure from below and above respectively, with a total disregard for the fact that this same pressure should prevent the formation of a hammer-shaped toe.

Lake[1] explains the occurrence of hallux valgus and the separation found between the heads of first and second metatarsals as a result of explosive strain at this point during the moment of take-off. This may or may not be true. However, he extends this same theory of take-off strain to explain hammer-toe and assumes that as the foot rises for the take-off, the head of the first metatarsal, with the bolstering effect of the sesamoids, rotates about the center of the metatarsal head. The other metatarsal heads, however, roll forward. Assuming that the tip of the toe remains fixed, this would most certainly produce the characteristic extensorflexion position of hammer-toe. The secondary piling up and hypertrophy of the soft tissues are supposed to increase the deformity further.

There are many objections to this theory. First of all, the deformity of hallux valgus, in itself, is certainly not the cause of hammer-toe. Even if the explosive strain of the take-off is the cause of hallux valgus, and there is debatable ground here, this is no reason for ascribing hammer-toe to the same mechanism. Secondly, the deformity of pes cavus, in itself, is not the cause of hammer-toe. Furthermore, hallux valgus is unusual with pes cavus. Thirdly, in claw foot, and other well developed conditions of hammer-toe, a normal take-off does not usually exist. The toes, especially the more deformed ones (Fig. 2), seldom bear weight. The patient very definitely does not roll forward, and claw foot will steadily become worse without toes ever touching ground; the forefoot is placed flat to ground and a characteristic "stilt-gait" often can be recognized.

The question of transient muscle paralysis or weakness has been advanced from time to time.[2] It has been pointed out that the interossei normally flex the first phalanges of the toes and extend the last two. If a transient paralysis and permanent weakness of these muscles is conceded, the unopposed extensors could cause hammer-toe, and, since the interossei center around the second digit, this must be given serious thought considering the frequency of a second hammer-toe. The only trouble with this theory is that such weakness has never been confirmed and there is other contrary evidence.

The doctrine of contracture following inflammatory changes in the sense of an ischemic contracture or that of Dupuytren is attractive but it will not bear analysis. The etiology is missing and so are the characteristic anatomical changes.

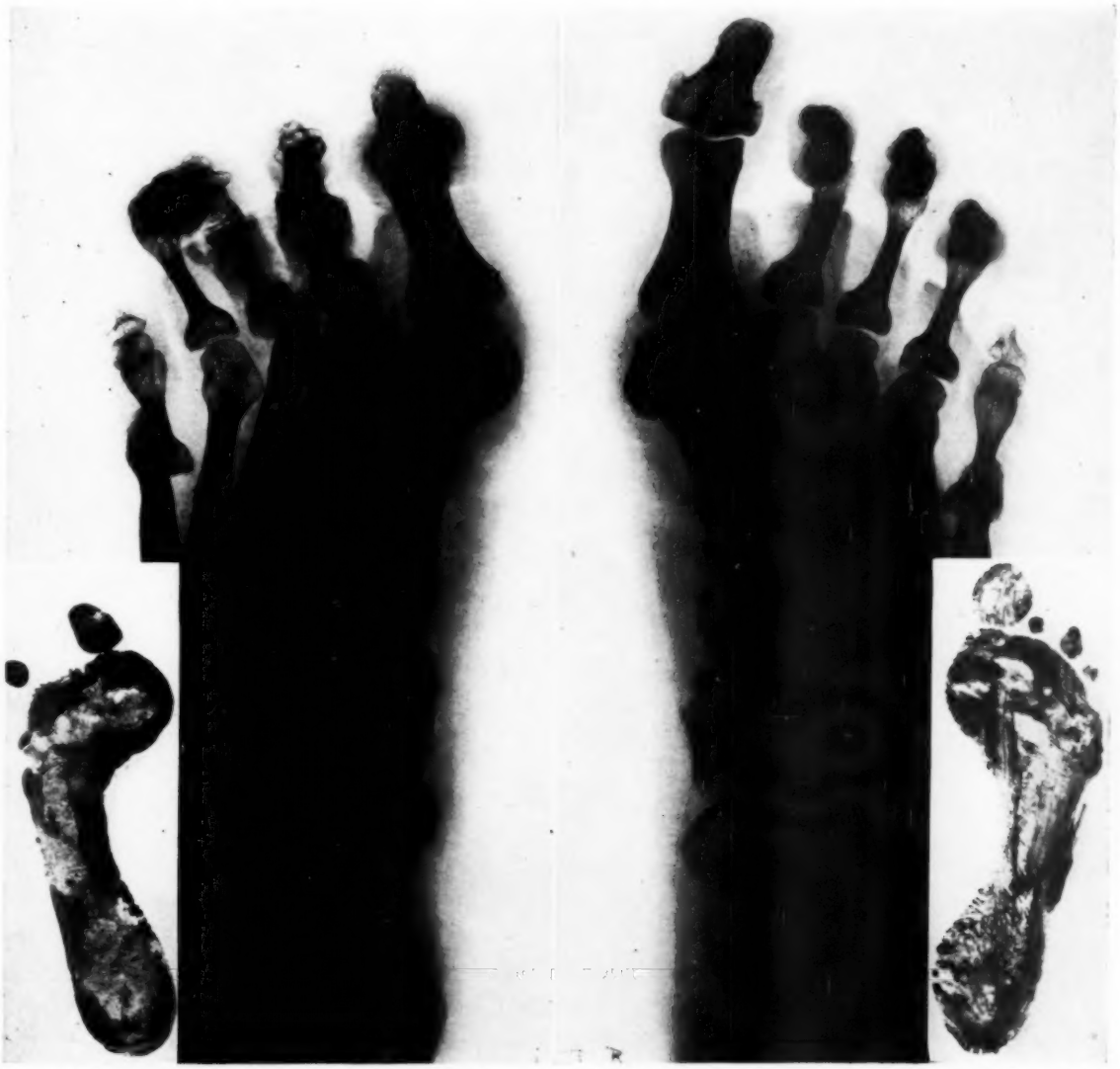

Fig. 2. *X*-ray picture and pedograph of claw feet. Note the high arch, varus tendency of the heel, and the inversion of the forefoot. Since the pedograph was made during locomotion, it will be seen that the toes bear little weight or none at all.

The question of spastic contraction of the flexors and extensors of the toes is quite another story. Much evidence has been accumulated to show that states of increased tonus can be followed by typical

hammer-toes even while the patient lies in bed without bearing weight. These have been repeatedly observed in Friedreich's

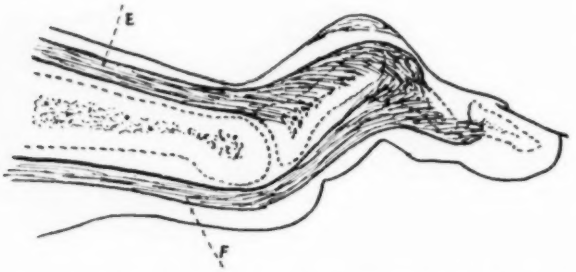

Fig. 3. Because of the peculiar insertion of the long flexor, F, and extensor, E, tendons, a preponderant, simultaneous pull on each will cause the typical hammer-toe position.

ataxia, Wilson's disease, spinal cord tumors, poliomyelitis, and other central nervous system conditions.

It has been recognized, that, given the normal mechanics of a toe, tension on the long flexor tendon and long extensor tendon, exerted simultaneously, will produce a typical hammer-toe as shown by Figure 3. An analysis of these feet during locomotion, or of spastic feet, clearly reveals the tense extensor tendons. Yet it is not a case of contracture, except possibly in the extreme cases, because most of the toes may be straightened too easily. The tension on these tendons is functional, particularly in the earlier stages.

Although it requires very little imagination or proof to visualize the formation of hammer-toe in a spastic limb by excessive simultaneous contraction of the flexors and extensors, this, apparently, does not explain their presence in a weight bearing foot that is not paralyzed or, as nearly as we can tell from the history, never was paralyzed.

The answer is, I believe, to be found in the excessive weight bearing of certain metatarsal heads. It is an axiom of the foot that long continued excess weight bearing will lead to hypertrophy and increased density of bone, particularly in the metatarsal heads. "Characteristic function and destructive structure go hand in hand."[3] It is also axiomatic that points of increased pressure and weight bearing develop callosities. It will be found that in a surprisingly large percentage of hammer-toe, the corresponding metatarsal shows these changes and the weight bearing area under the head is the seat of callouses and tender tissue. The metatarsal pain and tenderness, usually present, finds expression in the extent to which metatarsal bars are used in treatment. As shown in the case illustrated in Figure 1, the callus occurs most frequently under the more deformed toes. But as a matter of fact, it is a recognition of this excess weight bearing on the head of the metatarsal which led Lake to evolve his theory of take-off strain.

Saxl[4] has recognized the relationship of inflammatory transverse flat-foot to hammer-toe but ascribes the toe deformity to relative insufficiency of the interossei and lumbricales with a resultant functionally preponderant extensor. This may be an occasional factor but meets with the same objections which tend to nullify the theory of transient paralysis or chronic weakness.

A still further analysis of certain cases convinces one that this functional tension is an attempt on the part of the individual to remove painful pressure from the metatarsal head. Except for the extensor digitorum brevis, there is no constant mechanism for dorsiflexing the metatarsal heads themselves; it is a fact that only the extensor hallucis brevis has a metatarsal insertion, the remaining heads of the extensor digitorum brevis most frequently inserting into the bases of the proximal phalanges of the second to the fifth toes and blending with the extensor digitorum longus to aid the latter in dorsiflexing the toes.

In the event that a metatarsal head becomes painful, there is no mechanism available for relieving its weight bearing function through a dorsiflexing action except by the poor substitution of hyperextended toes. It is an effort on the part of the foot to withdraw the metatarsal head from intolerable pain—it is a position of relief.

Certainly other deforming factors cannot be overlooked, such as, the valgoid position of the great toe in bunion or the pressure of ill-fitting shoes, but these are incidental factors only.

The patient whose feet are illustrated in Figures 1 and 2, affords an unusual opportunity to study the development of hammer-toe over a relatively short period of time.

Case 1. The history, in brief, is that of a white male, thirty-two years of age, whose early history is negative except for pneumonia at five months and typhoid fever at five years. There was no known poliomyelitis or other nervous system lesion. He had always had high arch, but suffered no pain or disability. During university matriculation in 1923, the high arch was noted and he was placed in a special foot corrective gymnasium class. No hammer-toe was ever detected until the onset of rheumatic fever in the fall of 1929. Although beginning in the fingers and ankles, the process later involved the foot and particularly the forefoot. For over three years he had recurrent attacks of arthritis involving the metatarsal heads without any of these ever quite receding to a normal state. During this period, walking was very difficult, and, at times, impossible and at no time was the forefoot ever able to bear full weight. By 1932, the toes were much as they are shown in Figure 1. The metatarsal heads are still painful on extended walking and a bar is worn constantly. All toes, even the luxated fifth toes, can be straightened, some, however, requiring tension. The foot itself is not rigid but pes cavus is more pronounced now than it was ten years ago. As noted by the *x*-ray picture and the pedograph (Fig. 2) evidence of the active process has disappeared.

CLAW FOOT

Claw foot is the descriptive name commonly applied to a combination of high arch (pes cavus) and multiple hammer-toe. Pes cavus varies considerably in extent and degree but its characteristic feature is a high arch, created primarily by a lowering of the forefoot, this occurring most often at the astragaloscaphoid articulation. The result is a foreshortened foot with reduction in treading surface, prominent metatarsal heads, and shortened plantar structures. In more advanced stages the foot loses flexibility and it becomes impossible to passively raise the metatarsal head with a resulting correction of the deformity. Dorsal flexion may be limited but this is usually the result of dropped forefoot and not a contracted Achilles tendon. Progressively, the deformity may increase, with, oddly enough, calcaneal varus combined with eversion of the forefoot, rigidly contracted hammer-toes and much pain and disability. Extreme cases present an exaggeration of all factors with absolute incapacity.

The cause of pes cavus is uncertain. It is easy to understand why an arch will flatten under the influence of superimposed body weight; it requires considerable ingenuity to explain a progressively elevating arch under the same conditions of weight bearing.

The most satisfactory explanation considers the actual origin of pes cavus as a functional neuromuscular imbalance. For whatever reason, one or more of the elevators of the longitudinal arch (flexor digitorum longus, flexor digitorum brevis and posterior tibial) become functionally preponderant over the extensors of this arch (calf muscles, toe extensors and peroneal muscles). This disturbed balance of power with a surplus in favor of a lowered forefoot, if persisted in for long, is followed by secondary contraction of plantar structures and finally to such bony changes in the midfoot that flattening becomes physically impossible. The cause of this functional neuromuscular imbalance may be varied and includes many lesions of both the foot and the nervous system. The retracted toes are but the expression of an effort to raise the metatarsal heads through the medium of the toe extensors.

For more extended reviews of this subject consult Mills,[5] Stuart,[6] Steindler,[7] Goff,[8] Parker,[9] Royle,[10] and Saunders.[2]

TREATMENT

Something may be accomplished in a preventive sense during the early stages of

hammer-toe and claw foot. Naturally, shoes should be designed to fit the foot and high heels avoided. But this is not sufficient. Hammer-toe, itself, can be passively manipulated and the accompanying metatarsal head raised by padding. Plantar corrective plates have been devised, these to be worn at night. The average patient kicks them off because of discomfort. Associated flat-foot must be treated through posture reeducation, supports, exercise and alterations in locomotion. Hallux valgus of any degree yields poorly to any but surgical therapy.

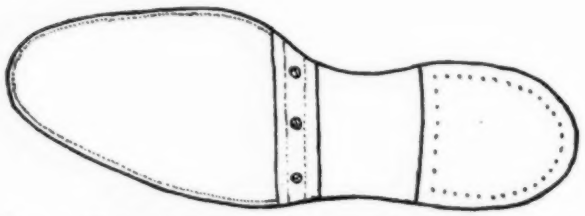

Fig. 4. Illustrating the position on the shoe of a metatarsal bar.

In certain adolescent cases of high arch, the feet must be watched closely. Low or no heels at all help somewhat. A metatarsal bar is useful and, in many cases, provides surprising relief when affixed to the shoe about an inch behind the metatarsal heads parallel to their line. A properly designed bar (Fig. 4) is at least 3/8 inch in thickness. If a shortened Achilles tendon is found, and this is not too common, stretching under anesthesia followed by the application of a plaster cast with the corrected foot in dorsal flexion is effective. Passive correction and wrenching of early pas cavus seems to result in recurrence in a majority of instances. One must also keep in mind Goff's[9] experience with the pes cavus of congenital syphilis and exclude this as an etiological factor.

In probably no other surgical sphere must treatment be so highly individualized as in deformities of the foot. It is true that gross similarities in certain malformations have engendered standardized procedures but it cannot be too strongly emphasized that procedures to be collectively successful must be individually selected and extensively, even radically, carried out. We have seen that hammer-toe is frequently a complication of other foot deformity and usually takes but a part in the "custom-therapy" which is so important in these cases.

Hammer-toes[12] may be amputated but this is not always desirable lest the resulting deformity create more disability than the original toe. In case the neighboring toes are too rigidly in juxtaposition, or the distal nail portion badly deformed, it may be a useful procedure when combined with other methods. There is probably no better way than amputation for dealing with a fifth hammer-toe if one is careful to leave a thick pad of tissue to cover the metatarsal head. Resection of the terminal phalanx or the proximal phalanx alone has been advocated and is probably useful in isolated instances.

Tenotomy, alone, of flexor and extensor tendons has been advised. This, of course, leaves a flail-toe which is less of a disadvantage than one would imagine in a shoe-wearing race. There are more physiological methods however.

The common operation is that of interphalangeal arthrodesis,[13] the object being to provide firm bony union between the proximal and middle bones of the toe. Fibrous union is unsatisfactory in that the toe redeforms and is painful under stress. To accomplish a good result an elliptical incision completely excises the knuckle of the toe, taking with it corn and bursa, and the dorsal extensor tendon is severed to allow ready access to the joint. The head of the proximal bone is excised completely and with it the joint bearing surface of the second phalanx together with the joint capsule as illustrated in Figure 5. This should be sufficient to allow full correction of the deformity. It is unnecessary to disturb the lateral digital arteries. The wound is closed with non-absorbable sutures and a firm dressing applied. The toe may be bandaged in corrected position to a plantar splint or to the neighboring toes until bony

union is secure. Trethowan[14] uses a small collodian gauze bandage, which is kept in place for two weeks and after this period

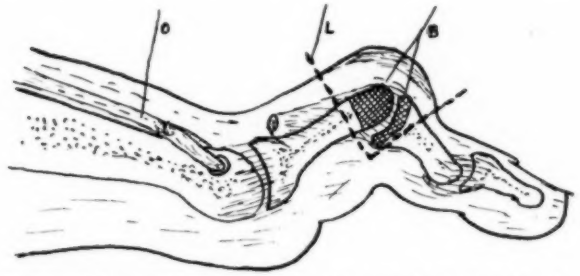

Fig. 5. Schematic illustration of the method of arthrodesis used in hammer-toe. O, optional transplantation of long extensor tendon; L, line of skin incision; B, bone to be excised.

the sutures are removed. Following this, splinting must be used as above.

Higg's[1] modification, in which the proximal phalanx is sharpened to a point and inserted into a corresponding depression hollowed out of the second phalanx, is said to afford a more secure splinting. With the extensor tendon, Jones severs the flexor tendon; this might be advisable in some cases but is usually unnecessary if complete excision of the joint is done. Often, much good is accomplished by transplanting the extensor tendon to the metatarsal head as described under the treatment for claw foot.

If hallux valgus or flat-foot is present, these must be corrected if possible at the same time. These procedures have been described by others and will not be reviewed here.

The correction of claw foot has always been difficult because of its tendency to recurrence. At the present time, the moderate and more severe grades are treated rather radically, and necessarily so. In general, there are two problems to solve: the shortened plantar structures and the dropped metatarsal heads. Whether either or both are corrected depends upon the degree of deformity.

In mild cases, in which the deformity disappears on standing, it may be enough to manipulate the forefoot with a Thomas wrench while under a relaxing anesthetic. This is done in such a way that acute flat-foot is induced. The foot is placed in plaster in a position of marked dorsal flexion and

Fig. 6. Steindler's operation for division of contracted plantar structures; S, subperiosteal stripping of os calcis.

maintained for two weeks. Following this, shoes are worn with very low or no heel and with a metatarsal bar (Fig. 4).

In severer grades of claw foot more radical procedures are necessary. In dealing with the contracted plantar structures, Steindler's[8] operation is the most satisfactory. A curved incision is made on the inner aspect of the heel about ¾ inch above the plantar surface (Fig. 6). It extends from the back of the heel to a point well in front of the anterior process of the os calcis. By blunt dissection all structures are stripped subperiosteally from the undersurface of the os calcis and the plantar fascia and small muscles of the foot are thus freed at their insertions. This is extended transversely and includes the calcaneocuboid ligament. This should be followed by a flattening manipulation, after which the incision is closed with two layers of suture. Any considerable oozing may be controlled with hot packs.

The next problem is management of the dropped metatarsal heads. Most moderate cases are adequately treated by transplanting the extensor tendons to the metatar-

sal heads[15] in the following procedure. A longitudinal incision is made over the first metatarsophalangeal joint and extended

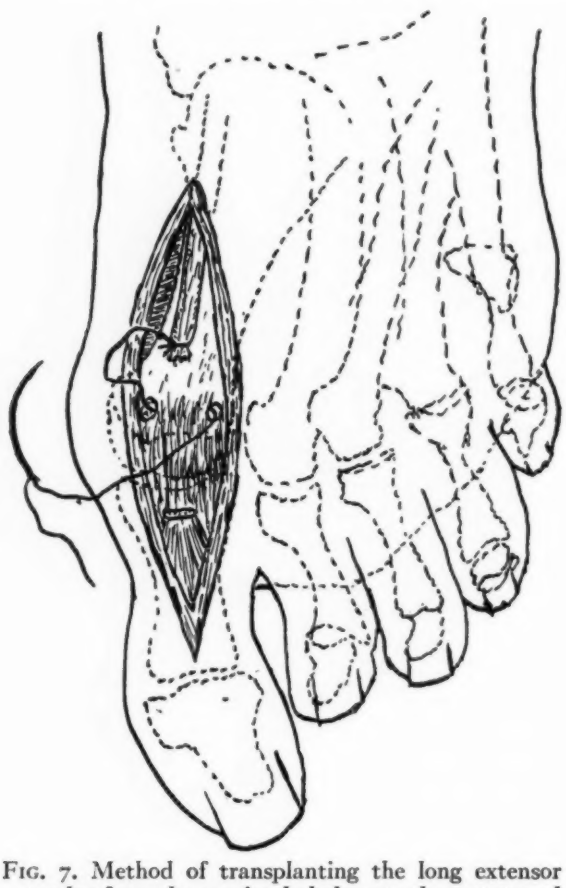

Fig. 7. Method of transplanting the long extensor tendon from the proximal phalanx to the metatarsal head.

to the interphalangeal joint. The extensor tendon is divided at its insertion into the proximal phalanx. With an assistant providing plantar pressure on the metatarsal head, a tunnel is created transversely, usually by drilling from each side to a common midpoint. The tendon is threaded through this with a silk suture on a slightly curved needle and pulled up sharply (Fig. 7). It is sutured with this silk to the proximal portion of tendon to form a loop. Interphalangeal arthrodesis is then done by an excision of the articular surfaces and the incision closed.

Next an incision is begun over the head of the second metatarsal, carried in a transverse direction across the other metatarsal heads and curved slightly over the shaft of the fifth metatarsal. The long extensor tendons are severed and transplanted in the same manner as the extensor hallucis

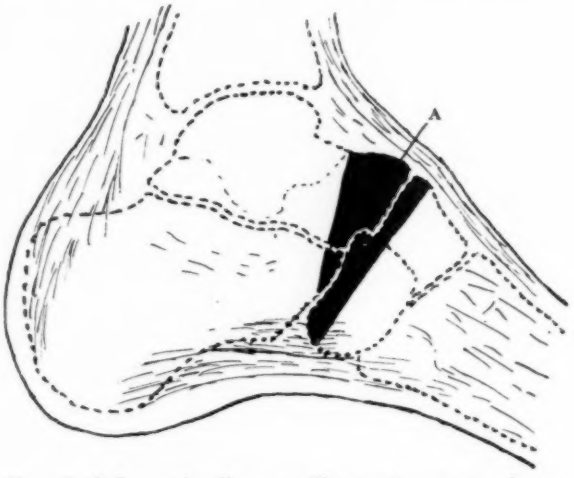

Fig. 8. Schematic diagram illustrating approximate average amount of bone removed by wedge shaped excision in severe claw foot or where ankylosis of the midfoot is desirable; A, area of resection.

tendon. At this time, if the subluxated toes do not readily return to a more normal position, capsulotomy may be necessary as advised by Heyman.[16] This is a simple transverse incision of the contracted dorsal aspect of the metacarpophalangeal joint capsule. The skin incision is closed and the foot put up in plaster in the corrected position. After two weeks, walking in plaster is permitted and finally shoes with a metatarsal bar are employed.

In the event that it is thought necessary to correct a midtarsal angulation—the result of marked bony changes—several procedures may be done depending upon the point of angulation.

Osteoclasis of the shafts of the first and second metatarsals near the base has been utilized. This has the advantage of correcting bony deformity to a certain extent without shortening the foot and without losing flexibility. However, in probably a majority of patients, the deformity will be found to occur at the astragaloscaphoid articulation. Besides, in all instances associated with definite paralysis or muscle weakness, it is highly desirable to ankylose the midfoot, at least in part. Consequently, a cuneiform osteotomy is done as illus-

trated in Figure 8. After retracting the tendons, a wedge shaped piece of bone is removed from the neck of the astragalus in sufficient quantity to correct the distorted arch fully. The osteotomy is then extended laterally through the cuboid or the anterior process of the os calcis as desired, these being easily exposed by further retraction of the tendons. The foot is retained in corrected position by a plaster cast until ankylosis is firm. This is usually six to eight weeks.

In extreme instances of pes cavus, Jones[17] advises preliminary astragalectomy followed by amputation of the toes and heads of the metatarsals. Fortunately, these cases are infrequent.

CONCLUSIONS

1. Hammer-toe represents an attempt, on the part of the extensors of the toes, to raise the metatarsal heads. It may be a functional spasticity of central nervous system origin. It may also be secondary to a painful metatarsal head, in which case it is to be considered a position of relief.

2. Claw foot is a deformity characterized by high arch, lowered forefoot, contracted plantar structures, and multiple hammer-toes. It is to be considered the result of functional neuromuscular imbalance from whatever cause in which the balance of power is in favor of the flexors of the longitudinal arch.

3. All deformities of the foot require individualization in treatment. To be successful, operative procedures must be considered collectively and carried out, if possible, at one time. Claw foot therapy in particular must be radical to be successful.

REFERENCES

1. Lake, Norman C. The Foot. Baltimore, Wm. Wood & Co., 1935.
2. Saunders, J. T. Etiology and treatment of claw foot. *Arch. Surg.*, 30: 179, 1935.
3. Morton, D. J. Mechanism of normal foot and flat-foot. *Jour. Bone and Joint Surg.*, 6: 368, 1924.
4. Saxl, A. Hammer-toe and transverse flat-foot. *Ztschr. f. orthop. Chir.*, 63: 154–160, 1935.
5. Hibbs, R. A. An operation for "claw foot." *J. A. M. A.*, 73: 1583, 1919.
6. Mills, G. P. Etiology and treatment of claw foot. *Jour. Bone and Joint Surg.*, 6: 142, 1924.
7. Stuart, F. W. Claw foot—its treatment. *Jour. Bone and Joint Surg.*, 6: 360, 1924.
8. Steindler, A. Operative treatment of pes cavus. *Surg., Gynec. and Obst.*, 24: 612, 1917; and The treatment of pes cavus. *Arch. Surg.*, 2: 325, 1921.
9. Goff, C. W. The pes cavus of congenital syphilis. *J. A. M. A.*, 86: 392, 1926.
10. Parker, C. A. Hollow-foot, pes cavus. *J. A. M. A.*, 61: 1886, 1913.
11. Royle, N. D. Claw foot. *Jour. Bone and Joint Surg.*, 9: 465, 1927.
12. Creer, W. S. Treatment of hammer-toe. *Brit. Med. Jour.*, 1: 527 (March 16) 1935.
13. Jones, R. Hammer-toe. *Brit. Med. Jour.*, 1: 782 1916.
14. Trethowan, W. H. The treatment of hammer-toe. *Lancet*, 1: 1257, 1312 (June 20) 1925.
15. Forbes, H. M. Claw foot and how to relieve it. *Surg., Gynec. and Obst.*, 16: 81, 1913.
16. Heyman, C. H. The operative treatment of claw foot. *Jour. Bone and Joint Surg.*, 14: 335, 1932.
17. Jones, R. Claw foot. *Brit. Med. Jour.*, 1: 749, 1916.

SIMPLE TREATMENT FOR PUNCTURE WOUNDS

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MILWAUKEE

THE designation "puncture wound," immediately brings to mind a wound, small on the surface but of variable depth, and most common in the sole of the foot. In this situation, as everyone knows, the offending nail protrudes vertically upwards from a board, unnoticed by the unwary pedestrian. In some cases the foot is actually transfixed by the nail or spike. The next most common site is the palm of the hand; less frequently in other situations. Other vulnerating agents may be the culprits, as in impaling injuries, in falls astride a sharply splintered broken board, but typically, when puncture wounds are thought of, the offending object is a nail or spike.

It has been the accepted teaching of bacteriology for over a generation that it is impossible to produce tetanus in an experimental animal by the injection of a pure culture of Bacillus tetani, the tetanus *toxin* having been excluded. The tetanus organism, being an anaerobe, will not flourish in pure culture in the living tissues for the blood stream furnishes a sufficient supply of oxygen to inhibit its growth and multiplication. Some factor which eliminates this inimical oxygen supply is needed if clinical tetanus is to ensue, and in the natural state, this is usually a contaminating common pus producer. These facts are well known to the surgeon; he accepts their teachings on Sunday, but in his practical work on Monday, he wavers and loses the courage of his convictions, his defenseless patient gets "the works" and reaps the results thereof as indicated below. Clearly then, preventing tetanus in a puncture wound accidentally acquired becomes a matter of preventing pyogenic infection, which should be done in any event, and is an extremely simple matter.

For about a quarter of a century, after having noted the dissatisfaction and impracticability of treating such lesions by free incision, the giving of antitetanic serum, etc., as directed by our highest authorities and authors of standard texts, I have used the simple method described below to the exclusion of all other methods, with entirely satisfactory results and no regrets. The chief difficulty was the painfulness of such procedures and the consequent lack of enthusiasm for them by the patient, which resulted in poor cooperation. If such treatment were universally carried out, probably 50 per cent of patients now treated professionally would shun the doctor and place their faith in grandma's flaxseed poultice, or "rattlesnake oil" supplied by the itinerant vender.

TECHNIQUE

It is assumed that the wound is a recent one, that is, not over twenty-four hours old. In wounds much older than this, and in cases where infection is fully developed, to speak of prophylactic treatment is of course meaningless. After simple cleansing, the wound is probed to determine its depth and the presence or absence of foreign bodies, which are removed if present. A strand of silkworm gut is now boiled, doubled at least twice (except for the smallest wounds) and introduced to the bottom of the wound and withdrawn not more than ¼ inch. The protruding end of the drain is bent at a right angle and fixed by means of adhesive securely to the skin surface close to the edge of the wound. The drain is withdrawn slightly every day or every other day, and by the fifth day, may in the majority of cases be finally removed. A simple gauze dressing completes the treatment. Rest is enjoined.

Wounds treated in this manner will not develop tetanus or any other infection if an experience of twenty-five years with it is any criterion.

The objections to the use of antitetanic serum are quite well known but may be briefly stated. (1) In patients sensitive to horses, a violent anaphylactic shock sometimes lethal, will result in a few minutes, an eventuality still sometimes unheard. Besredka's method of desensitization is unsuited for office use and bovine sera are generally not available. (2) The anaphylactic state, if not present, may be produced by a single injection, to plague the patient and his attendant at some future date. (3) Even in the absence of an immediate severe reaction, the patient usually spends a sleepless night unless generous use of narcotics is made, and, (4), but least important, the matter of expense.

CONCLUSIONS

The treatment of puncture wounds can be made very simple. Silkworm gut is the perfect drainage material. It does not swell and so does not act as a plug. A proper esteem for efficient drainage in accidentally produced puncture or other wounds will be revived in the practitioner who is called to resume the treatment of such wounds after someone has sewed them tightly in the first instance. This writer has seen some well-nigh disastrous results following such treatment.

PARONYCHIA

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PHILADELPHIA

As here employed the term paronychia refers only to those infections which start in the skin lateral to the finger nail, and which, unless aborted by active natural resistance or by surgical treatment, tend to spread by way of the eponychia to the other side of the nail. A shorter, and perhaps clearer, statement would be that it refers only to the infections commonly known as "run-around" or "ring-around" (Fig. 1).

Fig. 1. Untreated paronychia. (Kanavel, Infections of the Hand. Phila., Lea and Febiger.)

Fortunately for mankind the potentialities for development of these infections into life-threatening, or permanent finger-disabling processes are not great and in no way comparable to the dangers of the infections of the pulp of the finger. On the other hand these infections may be temporarily disabling to a considerable degree, depending largely on the occupation of the victim, and for a period of time, out of all proportion to the actual damage of the infection.

The severity of the suffering and the duration of the disability from these infections, as is so often the case in other conditions, depend on the promptness with which efficient treatment is applied. Responsibility for delay may rest with the patient, who has applied home remedy until no longer able to endure the discomfort; or, unfortunately, with the physician, who has either not grasped the significance of the situation, or may have been unwise enough to continue insufficient treatment on the patient's refusal to permit the indicated incision.

Such infections may have their origin in recognized trauma or may develop in the entire absence of any visible break in the integument. The well known "hangnail" or "stepmother" is a rather common entrance point of infection. Other, unfortunately not infrequent sources of infection entrance, are the small traumatisms sustained during manicuring.

The anatomic structure of this part of the finger is such that, excepting in the rapidly spreading cellulitis types of infection, resulting from streptococcus implantation, the inflammatory process in paronychia remains limited to the immediate neighborhood of the lateral margins of the nail, and the proximal part of the nail-bed. The more serious aspect develops when the inflammation extends to the tissues beneath the nail at its base. Under these circumstances pain becomes exquisite, and continues so until pus discharge occurs; and the period of local disability, even though pain relief may be almost complete after pus discharge, is of six to twelve weeks duration.

The bacteria responsible are the common pyogenes, Staphylococcus aureus and albus in particular.

A chronic variety of paronychia is at times seen in which over a period of months there is injection and thickening of the eponychium with an unsightly, red, elevated area of skin bordering the nail. At times there is discharge of small droplets of pus from beneath the eponychium, and it is the seat of constant discomfort of varying intensity. It is quite certain that this type of paronychia is largely occupational in its causation being more commonly seen in florists, bakers and laundresses.

The therapy of the two forms is entirely different. Because the more common form is that first mentioned, and because the "family" physician is the one usually first consulted, it will be given first consideration.

The basic principles of treatment, namely, establishment of drainage and its maintenance are the same as for treatment of local infections elsewhere. The details suggested are designed to assure the continuance of these necessities.

When seen early, within twenty-four to forty-eight hours of onset, the area of redness is limited to one side of the nail, and commonly in the distal half of the nail-fold. The part is swollen and exquisitely painful, and close inspection will usually reveal a slight yellowish discoloration of the skin close to the free edge of the nail. This early is not a superficial discoloration, like the pointing of an intradermal pus collection, but a modification of the skin color by the pus beneath. At this stage a small lateral incision over the point of greatest tenderness allows the escape of a drop or two of pus, and recovery promptly follows. It may be necessary to give consideration to anesthesia, even though the incision cannot be large and is quickly accomplished by a sharp bistoury. Local use of ethyl chloride is usually sufficient to reduce the incisional pain, and does not produce devitalization of the tissue, though the discomfort after thawing may be considerable. The discomfort incident to local anesthesia is moderate, but the postoperative anesthesia continues sufficiently long to carry the patient over the period of traumatic increase in pain and therefore is of value. If used, it should be injected into the lateral surface of the middle phalanges and not in proximity to the infected area. One per cent novocaine is sufficient concentration; addition of adrenalin is not necessary to prolong the anesthesia, and 2 c.c. injected on either side, with a five minute wait for diffusion, is usually sufficient. Such local anesthesia or a general anesthetic is necessary in the more radical treatment to be considered later.

The incision made, the dressing to be employed is to be given consideration. It must maintain freedom of drainage and attempts at use of drainage material in these small incisions is not only futile, but absolutely contraindicated. A continuous wet dressing of a mild antiseptic serves the necessary purpose. There is little to choose between boric acid, weak bichloride, 1:4000, hypochlorite solutions, or sodium citrate. The essential virtue of the wet dressing is maintenance of moisture. To this end a large, wet, gauze dressing is applied, of sufficient bulk to keep the part quiet and to provide a protection against bruising, and to hold a considerable amount of water.

To delay drying a covering of wax paper or cellophane is to be applied before the bandaging, and explicit directions must be given regarding the immersion of the whole dressing in the chosen antiseptic solution at regular intervals in order to maintain saturation—drying of the dressings, with adhesion of the blood and pus to the wound edges, absolutely defeats the purpose for which the incision was made. Recovery is usually far enough advanced that a light mild ointment, such as boric acid U.S.P., can be used at the end of forty-eight to seventy-two hours, and healing is complete in approximately a week.

When, however, the condition has been present longer, and infection is no longer

limited to the skin tissues but has found its way beneath the base of the nail and pus has been formed there, the treatment is not

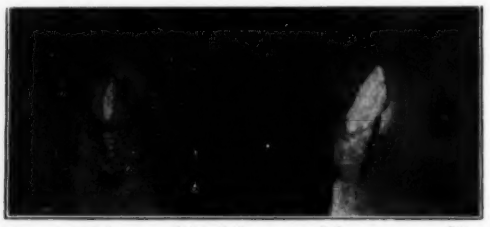

Fig. 2. Lines of incision used in paronychia. (Kanavel, Infections of the Hand. Phila., Lea and Febiger.)

so simple. Drainage must still be secured and maintained. The simple incision will not suffice; it is essential that the undermined area of the nail be removed, else infection will continue to spread beneath that structure until it reaches the other side of the finger, with ultimate loss of a large portion, if not all, of the nail.

If the area involved is not yet extensive the eponychium may be pushed back until the nail-edge is reached, a sharp pointed scissors inserted under the nail and all of the undermined portion removed. If removal is not complete, extension of the process continues; the area of the exposed nail-bed swells above the level of the part, like a fungating mass, further impeding drainage; the pain continues, making dressing a trying procedure, even though all the precautions before mentioned to maintain moisture are followed.

If there is any element of doubt concerning one's ability to remove the undermined nail completely the more radical and most effective lateral incision should be made. To avoid injury to, and prevent possible subsequent permanent deformity of the nail bed, meticulous care must be made to place the incision lateral to, and not through the nail-bed. With the flaps elevated and turned back, the loosened part of the nail is removed, a rubber strip or vaselined gauze is placed between the skin

Fig. 3. Flap has been raised and the point of the scissors inserted under the base of the nail. (Kanavel, Infections of the Hand. Phila., Lea and Febiger.)

flap and nail-bed and the wet dressing applied as before. Where extension has reached the opposite nail border a bilateral incision is required (Fig. 2), the whole flap is raised (Fig. 3), and the proximal undermined nail removed, leaving the distal nail attached to the bed, where it serves the purpose of a natural, efficient protection during healing.

An annoying complication in these cases is the previously mentioned tendency to fungation-like elevation of the exposed base of the nail-bed. Control of this tendency is facilitated by reduction of bulk and substitution of dry dressings at the earliest favorable time. Kanavel has recommended that several hours exposure to direct sunlight be employed daily where possible.

Treatment of the previously mentioned chronic type of paronychia by the use of ointments and antiseptic solutions, has usually proved so disappointing that we have turned to the roentgenologist for his help. Through the courtesy of the *X*-ray Department of Temple University, I have received from Dr. Barton Young the following resume of their treatment of these very annoying conditions.

Roentgen treatment has been recognized as an aid in the treatment of infections but its real value is not universally appreciated. The application of *x*-rays to certain types of infection nearly always results in a subsidence of reaction which is at times prompt and spectacular. Our results with paronychia have been gratifying, but our cases have been limited, for the most part, to the chronic form, since we see paronychia only after other forms of treatment have failed.

Usually it takes only two or three treatments of from 75 to 100 *r* each to alleviate the symptoms, and produce resolution of the disease. The treatments are given every other day, or every third day, depending upon the course of the disease. We prefer unfiltered low voltage (90 — 100 K.W.P.) *x*-rays, using a target skin distance of 30 cm. There is no proof that reasonable variation of this technique will alter the beneficial results.

SUMMARY

The following may be listed as requisite in the treatment of the acute suppurative case of paronychia:

1. Early incision;
2. Complete removal of detached nail;
3. Avoidance of injury to nail-bed;
4. Maintenance of drainage by a voluminous dressing, kept moist until infection has subsided;
5. Light subsequent protective dressings until regrowth of nail.

FELON (WHITLOW)*

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PHILADELPHIA

FELON is a term applied to infections involving the finger, and most commonly affecting the distal phalanx on the palmar surface. The infection may be superficial,[1] known as a subcuticular and subcutaneous felon, or when deep is often called a subperiosteal bone felon. At times extension of infection by continuity or contiguity of tissue, especially in deep wounds or punctures, may lead to synovial thecal felon (suppurative tenosynovitis).

The mode of entrance of the infection may not always be clear. Forgotten injuries or abrasions as well as the dangerous punctured wounds are the common sources. Physicians and nurses frequently suffer from felons, due either to needle puncture while operating or in handling sharp pointed instruments. Constitutional debility and obese types may offer suitable soil for bacterial invasion.

The peculiar anatomy of the distal phalanx as pointed out by Kanavel, Koch and others, is a factor in the localized type of infection found in felon. The connective tissue framework produces a closed sac with septa containing columns of fat and glands which extend to the periosteum (Fig. 1). The blood supply is received from the two digital arteries which enter laterally and are enclosed in this fibroconnective tissue space. The epiphysis of the distal phalanx receives its blood supply from branches of the digital arteries before the blood vessels enter the closed space, the diaphysis receiving its blood supply from branches given off in the closed space (Fig. 2). The resulting pathological process can readily be seen. When infection enters the finger, the inflammatory exudate limited by the closed space and by the dense palmar skin, obstructs the blood supply to this vulnerable area. Early abscess formation and necrosis of the diaphysis can be expected.

SYMPTOMS

Pain is the most prominent symptom associated with redness and swelling. The pain in the beginning is usually sticking in nature, but soon changes to a severe pulsating type with marked tenderness. The finger tip by this time is bulbous and tense. If allowed to persist, lymphangitis may occur with signs of systemic intoxication, increased pulse rate and temperature. Proximal bone tenderness is not uncommon, often denoting periostitis or osteomyelitis.

DIAGNOSIS

The diagnosis should be readily made by noting signs of inflammation confined to the terminal phalanx, especially with history of injury. In the differential diagnosis, lymphangitis and tendon sheath infection should be eliminated, particularly in the early case. With these infections, swelling is usually diffuse, often involving the entire finger, most of the swelling being on the dorsal surface of the finger with flexion deformity, particularly in suppurative tenosynovitis. Difficulty in the diagnosis may be experienced in the late case, when lymphangitis of tenosynovitis has occurred from extension of the finger tip infection.

PROGNOSIS

Great care and judgment should be exercised in the management of hand infec-

[1] BABCOCK, W. W. Text Book of Surgery, Philadelphia, W. B. Saunders Co.

* From the Department of Senior Surgery, Temple University, Philadelphia.

tions. As pointed out by Koch,[2] there should be at least one member of a hospital staff properly trained to treat minor surgical conditions, especially infections of the hand, where good functional end results are so important. Koch properly states that such infections are usually treated by the most inexperienced members of the staff.

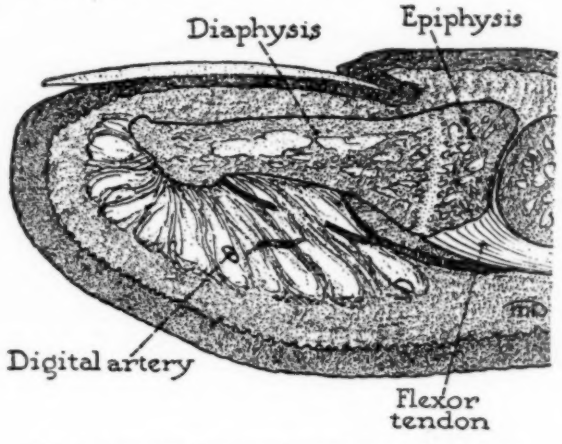

Fig. 1. Longitudinal section of terminal phalanx of finger, semidiagrammatic. Anterior closed space, in which felon develops, corresponds to the portion of the pad which overlies the diaphysis of bone. The epiphysis and termination of the flexor tendon lie outside this space. Small branches of the digital artery supplying the diaphysis pass through dense confines of the space and are quickly compressed by an inflammatory swelling. (Kanavel, A. B. and Mason, M. L. Hand Infections, Cyclopedia of Medicine, Vol. vi. Phila., F. A. Davis Co., 1932.)

When treatment by free incision is carried out before bone necrosis ensues, early resolution is to be expected. However, when osteomyelitis and bone necrosis occur, one must expect a discharging sinus until sequestrum has been removed or discharged. The resulting deformity and dysfunction will depend upon the duration of suppuration and the amount of tissue destruction.

TREATMENT

The prophylactic treatment of felon should preclude the sterilization of wounds, no matter how trivial, at the time of injury with a protective dressing.

With the onset of infection, absolute rest should be provided by the use of abundant moist dressings. A saturated solution of boracic acid, two parts, and alcohol 70 per cent, one part, is an excellent solution for such purpose. The dressings should include the entire hand and forearm. Provision should be made for introducing the solution at regular intervals for constant moisture with sufficient outside covering to maintain heat. Dressings should be removed daily for inspection. Careful observation to determine the proper time for incision is important. One should not wait for fluctuation. On the other hand, one should not incise until localization has occurred in the distal phalanx, and particularly one should not incise during the period of early lymphangitis. Incision during the early period of lymphangitis will be of no value and in many instances causes widespread dissemination of the infection along the lymph vessels of the hand, forearm, arm and at times blood stream invasion.

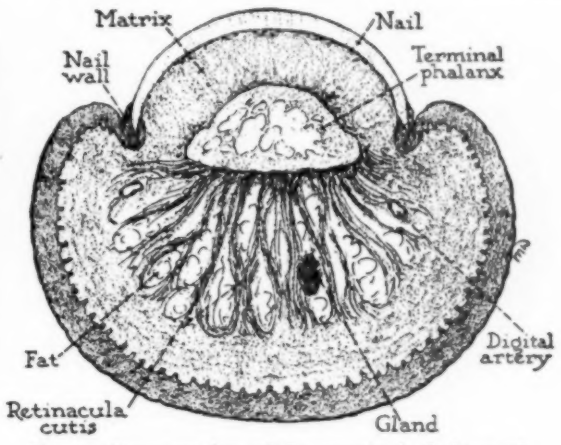

Fig. 2. Cross section of the terminal phalanx of the finger, semidiagrammatic. Dense fibrous columns (retinacula cutis) pass from the lower layer of the skin to attach to the periosteum. Between these columns is fatty tissue containing sweat glands, nerve fibers and blood vessels. To obtain adequate drainage of the felon, it is necessary to divide these fibrous columns. (Kanavel, A. B. and Mason, M. L. Hand Infections, Cyclopedia of Medicine, Vol. vi. Phila., F. A. Davis Co., 1932.)

[2] Koch, S. L. Editorial. *Surg. Gynec. and Obst.*, 60: 879 (April) 1935.

Kanavel[3] points out that the incision should be made as soon as the edema restricted to the distal phalanx has proceeded to a degree causing a hardness, but not necessarily the board-like feeling characteristic of pus in other subcutaneous areas. In general, one may say that when there is present a painful, tender, distal phalanx with excessive edema limited to the phalanx, incision should be made.

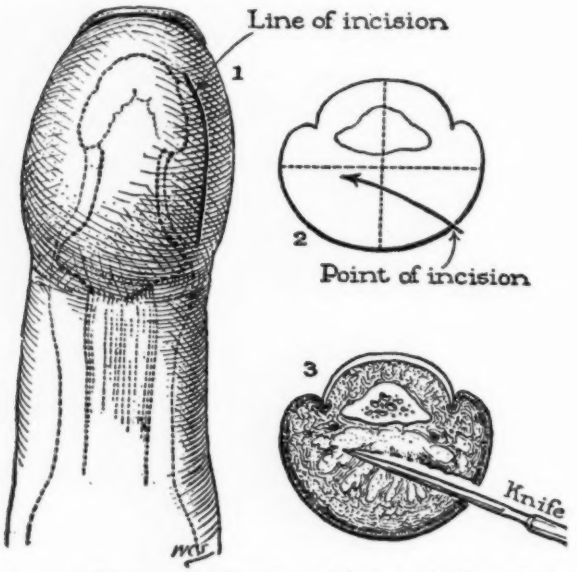

Fig. 3. Proper incision for drainage of felon. It is unnecessary and unwise to carry the incision across the tip of the finger. The essential feature of drainage is the transverse division of the retinacula of the skin. (From Koch. *J. A. M. A.*, April 6, 1929.) (Kanavel, A. B. and Mason, M. L. Hand Infections, Cyclopedia of Medicine, Vol. vi. Phila., F. A. Davis Co., 1932.)

The Anesthetic. The use of a general anesthetic[4] will allow the surgeon ample time to make an adequate incision to insure the best result. If local anesthesia is used, the digital nerves should be blocked at the base of the finger. The use of a local anesthetic or ethyl chloride in the zone of inflammation favors diffusion of the infection and inadequate incision.

Method of Incision. Naturally, the incision should be made over the area of greatest tenderness, particularly so if the case is seen early enough to decide that the closed space of the distal phalanx is partially involved. However, if it is realized that the entire distal phalanx is affected, the method of Koch may be used (Fig. 3). The incision should be placed to the side of the finger to preserve delicate tactile sensation, otherwise disturbed by a median incision. The knife is introduced on an oblique plane extending well to the opposite side of the finger, making a free incision with division of the columns of connective tissue and fat, thus liberating any associated discrete pockets of pus. In one's eagerness to make a free incision, the knife should not extend beyond the base of the phalanx; else, the flexor tendon sheath will be contaminated, favoring a tenosynovitis.

Vaseline gauze drains are suggested as rubber tubing may cause pressure necrosis.

Fig. 4. Deformity of terminal phalanx of thumb resulting from felon, improved by liberation of the scar and implantation of fat. (Kanavel, A. B. Infections of the Hand. Phila., Lea & Febiger.)

[3] Kanavel, A. B. Infections of the Hand. Ed. 6. Philadelphia, Lea and Febiger, 162.

[4] Koch, S. L. *J. A. M. A.*, 92: 1171 (April 6) 1929.

Excessive packing should be avoided; a thin strip of gauze introduced to the depth of the wound is ample. Early removal of the drain is suggested.

In the immediate postoperative treatment, abundant moist dressings should be applied to include the entire hand, as before described, during the period of localization, with rest in bed. For ambulant treatment, a splint extending from the finger tip to the elbow, with the use of a sling is to be considered for appropriate rest and immobilization to favor resolution.

Results. When incision has been delayed and mass destruction of soft tissue and bone has occurred, prolonged drainage is to be expected. In the case of necrosis of the diaphysis, drainage will continue until sequestrum has been discharged or removed. The removal of sequestrum may be facilitated by instrumentation, after partial separation has taken place. At no time should a curette be used on account of injury to or removal of periosteum, thus interfering with bone regeneration and function. Amputation should not be considered unless there has been complete destruction of the terminal phalangeal joint.

In the average uncomplicated felon, a good functional result is usually obtained. Plastic operations for correction of the deformity may be necessary (Fig. 4). Contracted scars of the finger tip may be liberated with implantation of fat, to improve function.

SUMMARY

The article deals with the cause and varieties of felon, together with a description of the anatomy and pathology. The symptoms, diagnosis and differential diagnosis are discussed including the management and prognosis of finger tip infections.

The treatment includes methods aiding localization, types of incisions and drains to be used, also the care of osteomyelitis and bone necrosis.

Four illustrations are used to explain the text of the article.

FROST-BITE: TREATMENT BY PASSIVE VASCULAR EXERCISE*

REPORT OF CASES

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FROST-BITE is a definite pathological entity prevalent in winter months and characterized by varying degrees of reddening of the skin, and if not properly and early treated, to actual gangrene. In most standard textbooks frost-bite is a subject which is passed over lightly with only a few lines; the best treatment for it being prophylactic, or, if the sufferer has been exposed to the cold enough to deserve hospitalization, advice is offered to await demarcation of the gangrenous process and do a necessarily mutilating amputation of a part or whole of a foot or hand. Rubbing snow and ice on the frozen extremities and other crude methods in use for centuries are still the most common forms of treatment used today.

In the past few years there has been great interest aroused in peripheral circulatory conditions in general with remarkable results in saving limbs where amputations were conceded to be the only avenue open as a life-saving measure. Various workers[1] have repeatedly shown that many cases of definite organic arterial occlusion evidencing actual gangrenous lesions responded to the newer concepts of conservative therapy, thereby avoiding amputation and saving the entire limb, making an economic restoration of a useful citizen instead of a public charge.

With these recent advances in vascular therapy in cases of arteriosclerosis, thrombo-angiitis obliterans, etc., there are varying degrees of vasospasm superimposed upon an organic obliteration. One of the greatest factors in the prognosis is this element of vasospasm and the development of a collateral circulation to balance tissue exchange in undernourished areas of ischemia.[2]

PATHOLOGY

There may be considered three stages of frost-bite depending on their severity:

1. The stage of erythema in which the part exposed becomes red, with severe burning and a prickling sensation which is followed by vasoconstriction and numbness. Further exposure may be dangerous due to this anesthesia and more damage to the part may develop. If exposure ceases at this point there follows an intense reddening accompanied by itching, prickling sensations and swelling. Recovery may be complete or chilblains may develop which are characterized by bluish areas or nodules in the skin with a red areola.

2. The second stage presents large vesicles or bullae on a red skin containing clear watery fluid which may heal or become the site of a persistent secondary infection. This stage resembles severe second degree burns.

3. The third or terminal stage occurs from prolonged exposure to freezing and the circulation to the part is completely shut off. Gangrene of a varying degree results.

It is a debatable question as to whether the pathologic effects are a direct result of the cold causing a coagulation of the tissue with a thrombosis of the blood cells within the smaller terminal blood vessels, or due to the vasoconstriction, or to a trophic nerve disturbance. There may be a tendon or bone injury in severe cases.[3–5] Osteoporosis may ensue with necrosis of bone and

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subsequent sinus formation. Joint spaces are narrowed or obliterated in late cases. Bone repair is slow. Epithelialization is extremely slow in cases that are allowed to heal spontaneously.

Fig. 1. Case 1. Second degree frost-bite of both hands twelve hours after exposure to zero weather. Note large blebs on fingers, swelling of forearm and wrist. Subcutaneous thrombosis.

Fig. 2. Case 1. One week later; after ten hours of passive vascular exercise therapy. Note the several layers of new epithelium; thrombosis under nails, marked destruction of skin of fifth fingers of both hands.

The clinical picture and what is known of the pathological picture together with the results to be presented point to an ischemia due to vasoconstriction as the basis of the condition. From a therapeutic standpoint this must be considered the one important factor. Undoubtedly, some of the damage is due to direct freezing and trophic changes. The only hope lies in the relaxation of the spasm of the arterioles with a reestablishment of an adequate circulatory balance.[6]

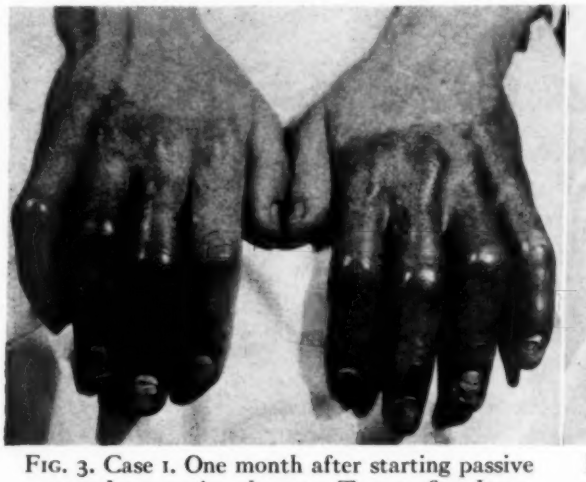

Fig. 3. Case 1. One month after starting passive vascular exercise therapy. Twenty-five hours given over this time. Note complete epithelization with line of frost bite on hands. Some swelling and stiffness of the fingers remain.

Fig. 4. Case 1. After physiotherapy over a period of three months.

PREDISPOSING FACTORS

Brahdy[7] emphasized many instructive points in a survey of 388 cases of frost-bite among New York City employees during the winter of 1933–1934. There were an unusual variety of cases which allowed a detailed analysis of the predisposing causes in this city. Thus he was enabled to reduce the incidence of frost-bite by giving timely warnings as to the proper clothes, habits, and ceasing outdoor work when the tem-

perature fell below 14°F. with a high wind blowing. The following are the factors emphasized as a result of this survey:

Fig. 5. Case 1. Return of normal function of flexion of hand and fingers shown.

1. The length of time of exposure after the first symptoms of numbness developed. Those workers who continued for several hours after this warning had the worst frost-bites.

2. Too rapid thawing was not advised nor was too prolonged rubbing with snow.[8] Body heat was less harmful, as by placing the hands in cotton or next to one's own body skin.

3. Age was not a factor except in cardiovascular disease or diabetes.

4. Clothing must not be too excessive to cause sweating and later chilling. Also shoes and gloves should not be constricting.

5. Alcohol is a factor only when taken too freely as to numb the consciousness. Many cases of severe frost-bite occur in drunkards on a bitter cold day.

6. Coffee and tobacco are known to lower the skin temperature by capillary constriction and are therefore not advised when one is exposing oneself to cold for several hours. Hot water and aspirin will cause a rise in skin temperature by vasodilation.[9,10]

7. Poor nutrition, as is found in relief workers, lowers their resisting power to exposure to severe cold.

8. Co-existing constitutional conditions of the exposed men, such as diabetes, myocarditis, arteriosclerosis, Buerger's and Raynaud's disease, made them far more susceptible to the more severe form of frost-bite.

9. Weather condition: When the outdoor temperature is below 8°F. and between 8° and 14°F. with strong winds, work should be postponed. Rest periods indoors of one-half hour periods should be allowed every two or four hours under these conditions. Frost-bite rarely occurred when the temperature rose to above 24°F. regardless of how strong the wind may be.[7]

TREATMENT

The treatment of frost-bite is threefold, the prophylactic, the conservative (passive vascular exercise), and the surgical.

Prophylactic. This is the wisest course in the long run. By observance of the points mentioned, we could eliminate frost-bite, but the condition of the workmen being as they are and human nature being what it is, we will nevertheless have a great number in the large cities each winter. Those suffering from diabetes, arteriosclerosis, peripheral vascular diseases and general asthenia should not be exposed to the hazard of freezing.

Passive Vascular Exercise Therapy. This conservative method of treating frost-bite has been borrowed from the armamentarium of several groups throughout the country who are treating organic arterial disease of the extremities with a great deal of success.[6] This method is one of creating alternate negative and positive environmental pressure within a glass boot into which the affected extremity is placed. The immediate effect on cases of frost-bite treated is the relief of the severe pain associated with the thawing out, enabling the sufferer to sleep. Depending on the severity of the frozen extremity the treatment may last for one hour daily to ten or twelve hours, or until a change to normal color is observed. It is remarkable how soon pallor is replaced by a normal pink color of the skin even after ten minutes of pavaex treatment. In severer cases in the second stage the numbness disappears, the large

blebs rupture spontaneously and new epithelium appears on the exposed denuded areas. Infection is controlled more easily as the circulation is restored by a relaxation of the vasospasm due to the frost-bite.

Where there is tendon injury as manifested by stiffness of the joint, this treatment is continued until the skin of the affected limb is entirely healed. Later, diathermy and massage will restore the normal function to a surprising degree.

These patients have the best results when they are given the passive vascular exercise treatments early after exposure. After twenty-four hours actual gangrene has occurred to the terminal digits, and the best that can be hoped for in the more severe type is a quicker demarcation for surgery. Even in this stage the pain is greatly lessened in the restoration of the partly damaged tissue, with the added benefit of a lower level of amputation than could be expected by waiting for spontaneous healing.

An added economic factor is the short time of hospitalization required in patients treated by this method, usually one to two weeks being sufficient. They can become ambulatory very soon and return to the clinic for further treatment. As a contrast to this, how many of patients have we seen in the hospital for three or four months and still visit the surgical clinics for dressing as late as July and August?

Herrmann[6] has reported similar results in frost-bite cases treated by passive vascular exercise.

A B

Fig. 6. Case III, A, chilblains due to frost-bite in a patient with infantile paralysis. Note hemorrhagic areas of local necrosis. B, front view.

CASE REPORTS

Case 1. D. B., male, twenty-five years old, fell asleep in snow on January 22, 1936, after drinking to excess. His hands were under soft snow for one hour or more. The temperature was near zero. On arriving home both hands

were swollen, stiff and numb and a cold water bath was given to the hands, the feet, and the ears. He was admitted to the hospital twelve hours following exposure, with a severe second degree frost-bite of both hands (Fig. 1) and first degree frost bite of both feet and ears, the latter clearing up quickly in a few days. The hands presented a serious problem with anticipated amputation of both hands. There were large blebs on all fingers, thrombosis under the finger nails, and loss of sensation in four fingers, sensation was felt over the metacarpal area. Immediate passive vascular exercise treatment was given to both hands. After one hour the numbness in the fingers was replaced by a feeling and the pain disappeared. After the glass boots were removed from the upper extremities, some of the symptoms returned and more pavaex was given. Each day thereafter each extremity received one hour of treatment. By the end of one week, ten hours of passive vascular exercise were given to each hand, resulting in subsidence of the swelling and several layers of epithelium present in different areas; the fifth finger of each hand still looked dry and was discolored by old dried blood subcutaneously (Fig. 2). At this time there was normal sensation in all fingers, but a definite stiffness in the small joints of the fingers. The patient was discharged after two weeks of hospitalization. Thereafter he was treated in the Clinic.

A B

Fig. 7. Case III. A, side view, after twenty-five hours of passive vascular exercise therapy over a period of one month; B, front view.

In one month he had had twenty-five hours of passive vascular exercise therapy with the result shown in Figure 3. There was complete healing of the skin but some swelling and stiffness of the fingers persisted, due probably to tendon injury at the time of the frost-bite. Other physiotherapeutic measures were pursued for the next three months, such as diathermy, active and passive motion, with the end results seen in Figures 4 and 5. Here we see normal skin with no swelling, skin folds restored, new nails in evidence, and a very

useful hand as is shown by the restoration of the tendon injury to a normal function of full flexion of the fingers (Fig. 5).

Case II. E. R., male, fifty-nine years of age, a P.W.A. snow shoveller, had the tips of the fourth and fifth fingers of the right hand frozen on January 24, 1936. He was treated for one month by the usual methods before he was sent to our clinic. There were still numbness and tingling of these two fingers; the fifth finger tip was reddened and slightly swollen, but the fourth finger was edematous in the distal two-thirds with a necrotic area 2 cm. by 1.5 cm. on the soft pad of this finger tip. A total of fifty hours of passive vascular exercise over a period of six weeks was given to this frozen member with the complete healing.

Case III. D. M., female, aged twenty-one years, presents a case of chilblains. Eight years previously she had had infantile paralysis of both legs. She has always complained of coldness and blueness of the legs during the winter months. One month previously, on January 24, 1936, she was exposed to severe cold weather, after which she experienced painful tingling sensations in her legs, which became aggravated when near heat.

This patient noticed that numerous bluish blotchy areas appeared under the skin on both legs but more so on the left leg in the lower half. Pedal pulsations were felt easily. The skin temperature of the distal half of both legs was subnormal. The dark areas were very painful, irregular subcutaneous hemorrhages and also involved the tips of the toes of the left foot. Treatment consisted of twenty-five hours of passive vascular exercise over a period of one month with the end results shown in the accompanying photographs (Figs. 6A and B, and 7A and B). All areas of chilblains are healed with a pleasant sensation of warmth of her legs not experienced by this girl in years.

SUMMARY

Frost-bite is a prevailing pathological entity not uncommonly found among outdoor workers during the cold winter months, especially at temperatures below 8°F., or between 8° and 14°F. in the presence of strong winds.

The underlying pathology results in the disturbance in the blood supply to the part by a marked vasospasm producing ischemia and anesthesia and if this vasospasm is not relieved within a period of twenty-four hours actual gangrene may result.

Prophylaxis is the most important factor in reducing the incidence of occurrence.

A comparatively new method of conservative therapy is offered in the alleviation of frost-bite, by the rapid relief of pain and the rapid restoration of circulation of the relaxation of vasospasm with a complete recovery in cases treated early. Late cases that have actual gangrene are relieved of pain and require less extensive surgery and a more useful limb therefore. Tendon injuries are not necessarily of a permanent nature. Epithelialization is rapid. Hospital stay is remarkably lessened as an added economic factor.

The passive vascular exercise therapy in frost-bite will enable the surgeon to change from the placid role of waiting for a time to amputate to an active role of trying to tide these sufferers through to a stage of actual healing by restoring their circulatory balance in a rapid and sound way.

REFERENCES

1. Herrmann, L. G. and Reid, M. R. The Pavaex (passive vascular exercise) treatment of obliterative arterial disease of the extremities. *Jour. Med.*, 14: 524–559, 1933.
Shipley, A. M. and Yeager, G. H. Passive vascular exercise in the treatment of peripheral circulatory disease. *Surg. Gynec. and Obst.*, 59: 480–485, 1934.
2. DeTakats, Geza. The differentiation of organic and spastic vascular occlusions. *Am. Jour. Surg.*, 94: 321, 1931.
Landis, E. M. Observations on peripheral vascular diseases. *Amer. Internat. Med.*, 8: 232, 1934.
3. Von Recklinghausen. *Deutsch. Chir.* Lief 2 and 3.
4. DaCosta. Modern Surgery. Ed. 9, Phila., W. B. Saunders, p. 110.
5. Nagelsaachm. *Muncben. med. Webnschr.*, 4: 353, 1919.
6. Herrmann, L. G. Passive Vascular Exercise. Phila., J. B. Lippincott Co., 1936.
7. Brahdy, L. Frost-bite among city employees of the City of New York. *J. A. M. A.*, 104: 529–532, 1935.
8. Macklin, A. H. Treatment of frost-bite. *Lancet*, 1: 884–885, 1925.
9. Bierman, W. Diagnosis and treatment of peripheral vascular diseases by physical agents. *New York Jour. Med.*, 36: 1405, 1935.
10. Barker, N. W. Vasoconstrictor effects of tobacco smoking. *Proc. of Staff Meet. Mayo Clinic*, 8: 284, 1933.
11. Kaplan, Theo. Frost-bite. *Am. Jour. Surg.*, 32: 318 (May) 1936.

HAND INFECTIONS: OFFICE TREATMENT

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INFECTIONS of the hand differ from infections in other parts of the body mainly because of the complicated anatomical structure of the extremity.

Generally there is too little stress paid to the macroscopic and microscopic anatomy of the various structures which compose the hand, and it was not until Kanavel's admirably thorough work was published that attention was directed to a more scientific view and a more efficient basis for their treatment. A realization of the technical possibilities, and an appreciation of the economic loss suffered by patients due to improper and inefficient surgical methods, have raised the standards which obtain today in the surgical treatment of hand infections.

Questions are frequently propounded as regards the proper limitations of minor surgery of the hand, or rather as to hand infections which may be treated correctly in the physician's office as distinctly minor surgical cases. The following, in our view, are the types which may be properly treated as ambulatory:

1. Infections around the nail, such as eponychia, paronychia and subungal abscess. In this class may also be included subungual hematomata, which are prone to infection.

2. Felons or terminal closed-space infections.

3. Collar-button or collar-stud abscesses, or lumbrical space infections.

4. Furuncles and carbuncles.

5. Cellulitis, with subcutaneous abscess formation.

Tenosynovitis, midpalmar space infections, thenar and hypothenar abscesses and subflexor space or Parona space infections, should be treated in the hospital because of their general severity, the danger of complications and postoperative deformities resulting in severe economic loss to the patient. It is an evidence of poor surgical, or other judgment, to attempt office treatment of these infections under general or local anesthesia. A complete operative room set-up for these patients is just as imperative as it is for an appendicectomy. An inexperienced or mediocre surgeon may at times successfully remove an easily accessible, acutely inflamed appendix; he is not justified however in operating on the hand unless he has a thorough knowledge of the surgical anatomy with its complexity of tendons, fascial planes, blood vessels and nerves.

Auchincloss wrote, "The story of hand infections centers about anatomical architecture. With no desire to minimize the importance of bacteriological, serological and chemical aspects, one must remember that it is their bearing on structures having an anatomical arrangement peculiarly their own that concerns us, rather than these subjects as general entities."

1. *Infections Around the Nail.* The nail, a modified skin structure, derives from the layer which is known as stratum lucidum; near its base is a whitish portion, denominated lunula. The entire nail rests upon a bed. The subjacent epithelium is the nail matrix. The subungual space, the area between the nail and the bed epithelium, is extremely vascular. A somewhat wedge-shaped structure of skin, the eponychium, lies dorsal to the nail-root. Between the eponychium and the dorsal skin is a layer of subcutaneous tissue rich in lymphatics but poor in fat. On both sides one finds the paronychium which is continuous with the eponychium and of a similar structure. The

skin in this region is noticeably more flexible and softer in consistency than on the palmar or volar aspect of the finger inflicted by a manicurist. A simple paronychia (Fig. 1C) may respond to the treatment recommended for eponychia, or one

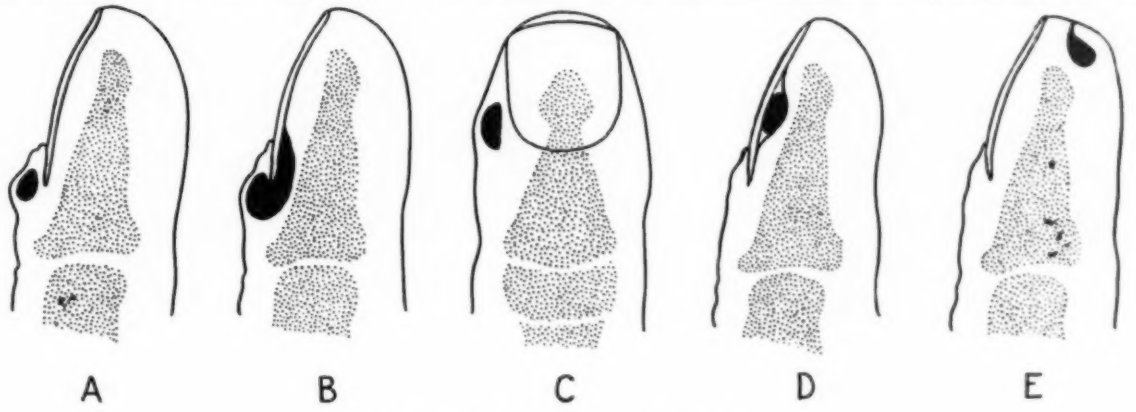


Fig. 1. Infections around the nail.

because of the greater flexibility and elasticity required of the entire dorsal skin surface of the finger to permit of flexion (Fig. 1).

Infections of the subcutaneous tissue, between the dorsal epidermis and the reflected epithelium of the eponychium, may result in cellulitis or it may localize and form a small abscess which appears like a pus blister. This type of infection is very mild and may be cured by gently pushing back the roof of the blister or pricking it with a sharp needle and allowing the pus to escape (Fig. 1A). The redundant, overlying epidermis is then clipped away to permit proper drainage. The insertion of a drain is unnecessary and wet dressings applied for a few days usually effect a cure. This condition is frequently confused with the more serious infection of the nail-bed which results in subungual abscess. Even though pus is not observable here under the nail, its presence is presumed on the basis of a simple eponychia which fails to yield to the mild form of treatment described (Fig. 1B). One may be suspicious of a subungual abscess if there is discoloration in the region of the lunula and a yellowish-white color due to the actual presence of pus beneath the nail.

In paronychia similar conditions are noted. This common infection frequently results from neglected hangnails or trauma to the cuticle over the base of the nail may find that the pus has burrowed underneath the nail forming a subungual abscess.

When the diagnosis of this type of abscess is made, with or without eponychia or paronychia, simple incision into the soft tissue will not always effect a cure. Pain is often unrelieved for several days after surgical intervention, and it will persist until the roof of the abscess, which is the superimposed nail, is removed (Figs. 1B and 1D).

It is inadvisable and unnecessary to remove the entire nail; it is generally sufficient to remove the base up to the distal margin of the lunula, care being exercised that a complete segment is removed and that no fragments of the nail are left at the juncture of the eponychium and paronychium which may act as plugs preventing adequate drainage. On removing the nail, one may not note a gush of pus, but it will be observed that there is, nevertheless, constant drainage of purulent material, and that relief usually follows within six or eight hours.

When a subungual abscess is associated with paronychia, some surgeons advise removal of the nail with its contiguous nail-bed on the side of the infection, thus preserving the remainder of the nail-bed and the nail. This is seldom necessary because the infections generally are located near the base of the nail and are cured only

on removal of the entire nail-base. The portion of the nail distal to the lunula, which is known as the body of the nail, is not removed. The exposure of a large, tender, vascular surface is thus avoided. When this is preserved, within a week after operation, the exposed portion of the nail-bed becomes dry and the remaining distal portion acts as a covering for the tender subungual tissue, and the patient is able to resume his vocation. The new nail will gradually displace the distal portion of the old nail without incapacitating the patient (Fig. 2).

Fig. 2. Subungual abscess associated with paronychia. (After operation.)

2. *Felons or Terminal, Distal Closed Space Infections.* These are infections of the palmar or anterior aspect of the finger at the distal phalanx. The reader will note in the accompanying illustrations that the terminal closed space is made up of what Auchincloss calls "fat caverns" which run anteroposteriorly from the chorium to the periosteum, and the terminal closed space extends from the tip of the finger to a point about ¼ inch distal to the crease and is completely separated or walled off by an envelope of fascial tissue not only from the flexor profundus tendon, but likewise from the epiphyseal end of the bone. Certain surgeons believe that there is a continuity of the so-called deep connective tissue trabecula with the periosteum of the bone, and that lymphatics are to be found between the skin and the bone. According to Kanavel, deep penetration of the sweat glands into the subcutaneous tissues is an important factor in hastening bone involvement. In addition to sweat glands, these columns of fat contain nerve filaments and blood vessels (Fig. 3).

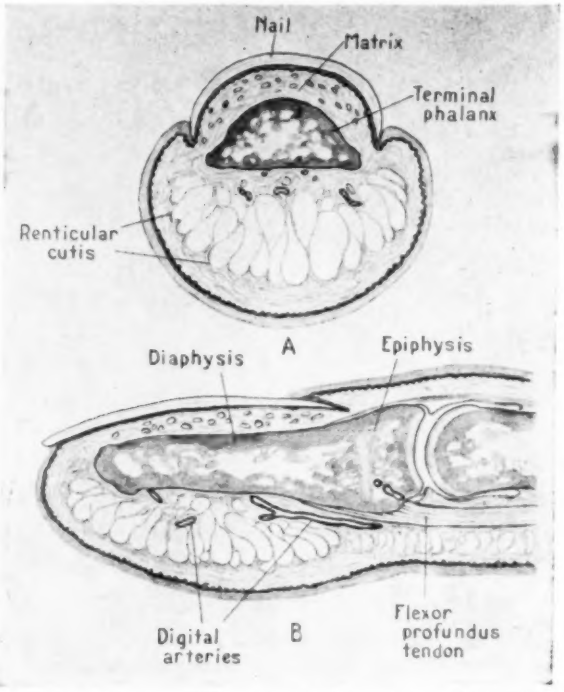


Fig. 3. Cross and longitudinal section of terminal closed space.

It is noticeable on careful dissection that the artery to the epiphyseal end of the bone is independent of the vessels that supply the more distal portion or shaft. The diaphysis of the phalanx is supplied by digital vessels and end filaments of the digital nerves. The epiphysis, however, receives its blood supply through small branches of the digital artery before they enter the closed space. These anatomical facts are important considerations in determining not only the course and rapidity of infection, but in the scheme of treatment.

Etiology. The etiological factor is usually a needle or pin prick or perhaps some unnoticed injury. The wound becomes sealed due to the toughness of the skin and the infection spreads immediately along the line of least resistance, which is towards the bone.

Symptoms. Pain, at first mild in character, becomes severe and throbbing within twenty-four hours as the tissue spaces fill with inflammatory exudate; in a few days the volar aspect of the terminal phalanx appears swollen and bulbous. The patient develops a temperature. If untreated, in about four days, the finger becomes fluctuant and exquisitely tender.

Diagnosis. The localization of the painful swelling and the shape of the distal phalanx, without extension of tenderness along the flexor tendon, are pathognomonic of terminal closed space infection. One rarely notes lymphangitic streaks extending up the forearm.

Treatment. The fascial spaces or fat caverns in the pulp of the finger run anteroposteriorly, and in order to empty these (Fig. 3), one must incise transversely so that the pus will drain readily from both ends of the divided channel. It is readily understood therefore why the fish-mouth or horseshoe incision (Fig. 4) should be the method of choice; and likewise, one may readily appreciate the futility of a longitudinal incision over the middle of the terminal closed space. The latter type of incision does not completely empty the purulent exudate, nor does it permit adequate drainage and it deforms the distal phalanx, disturbing, too, the tactile sense. On the other hand, the horseshoe or fish-mouth incision provides adequate drainage, heals with no deformity, and does not affect the tactile sense. Once the diagnosis is made, surgical intervention should be immediately instituted; and it may be carried out at the base of the finger under local block or infiltrative anesthesia.

An incision is made in the manner described and a piece of dry gauze is inserted between the two flaps for hemostasis. A wet dressing is not applied until about eight hours after operation. If used prior to this time, bleeding may be promoted by the hygroscopic action of the moist dressing. The wound need not be dressed for two days; thereafter daily dressings are in order. The packing is removed on the fourth or fifth day after thoroughly moistening the finger in order to loosen the gauze, thus permitting pain-

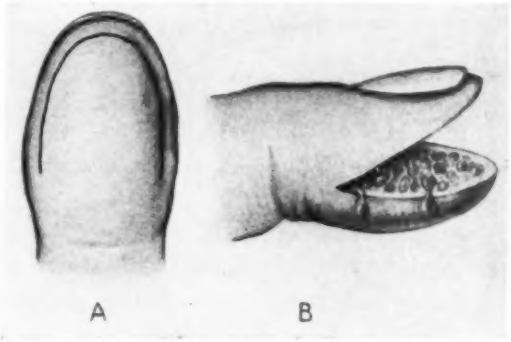


Fig. 4. Fish-mouth or horseshoe incision.

less removal. The purulent discharge practically ceases about the seventh or eighth day and balsam of Peru dressings are applied to the wound. Healing then takes places rapidly and at the end of a few weeks further dressings are unnecessary.

If the incision is properly made there is no danger of injury to the flexor tendon with resultant suppurative tenosynovitis. This complication may be avoided if the ends of the horseshoe are not carried nearer to the distal crease than one-quarter inch.

Complications. Osteomyelitis of the terminal phalanx, as a complication, occurs rarely. Absorption of calcium takes place in the terminal phalanx, on account of chronic passive congestion, and the *x*-ray plate gives the picture of an osteoporosis which is frequently mistaken for osteomyelitis. Almost the entire bone distal to the epiphysis apparently disappears, but one will note, after a period of three to nine months, that repeated *x*-ray examinations reveal a reappearance of the normal density of the terminal phalanx due to the impregnation of the fibrous matrix with calcium after the establishment of the normal bone and soft tissue circulation (Figs. 5A–I). In osteoporosis one does not note the stripping or elevation of the periosteum which occurs is osteomyelitis. In the latter case, the wound does not heal until the loose particles of bone are extruded or removed, and the osteoporotic appearance is more patchy

in type than in the physiological osteoporosis described (Figs. 6A and B).

Various etiologic factors are concerned in the bone involvement of terminal closed-space infections. They are:

1. The contiguity of the deep connective tissue trabecula with periosteum;

2. The perpendicular course of the lymphatics, from the skin to the bone;

3. The deep penetration of sweat glands into subcutaneous tissue.

3. *Collar-button or Collar-stud Abscesses (Subepithelial Abscess).* This type of infection is encountered in working men who have a thick palmar epidermis. It originates as a superficial infection beneath the epidermis which, in time, ruptures and burrows down through the dermis into the subcutaneous tissues. This infection may remain at times localized and rupture subsequently through the skin; when this is not possible, owing to integumental thick-

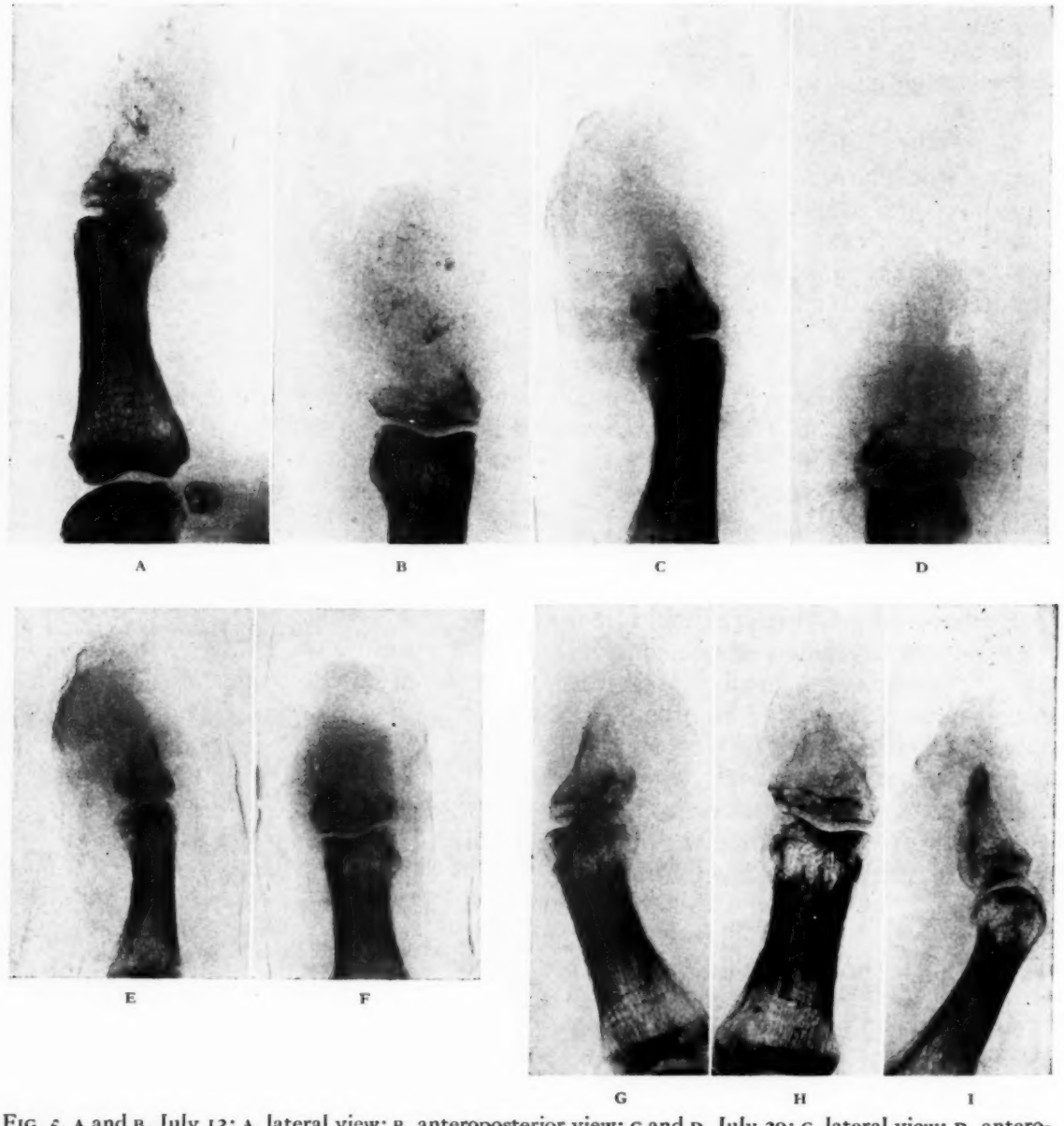
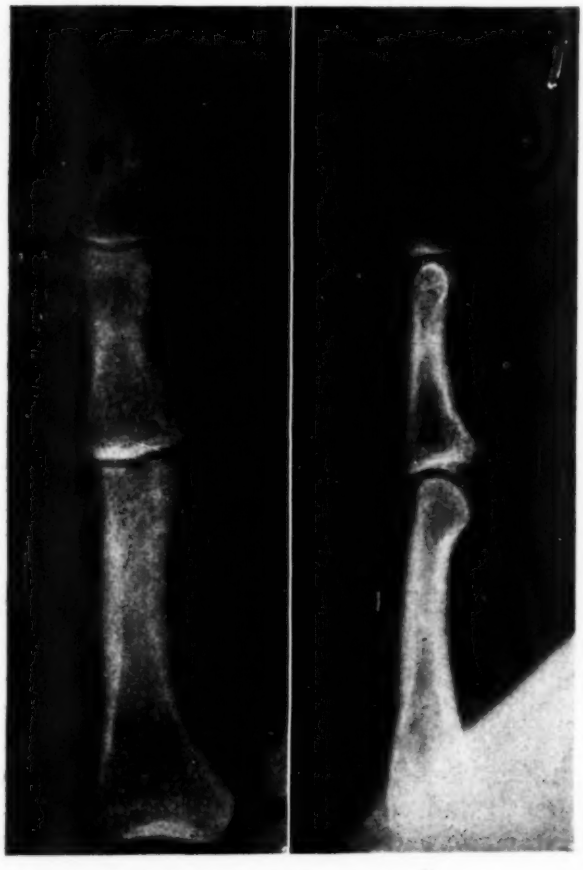


Fig. 5. A and B, July 13; A, lateral view; B, anteroposterior view; C and D, July 20; C, lateral view; D, anteroposterior view; E and F, July 27; E, lateral view; F, anteroposterior view; G and H, August 10; G, lateral view; H, anteroposterior view; I, lateral view, September 8.

ness, it may spread down through the skin fibers of the palmar aponeurosis forming a collection of pus between the lumbrical



A B

Fig. 6. Osteoporosis of a terminal phalanx, with a closed space infection, showing a restitution to normal after many months. The bone picture may be interpreted erroneously as osteomyelitis.

muscles pointing towards the web (Fig. 7). This peculiar type of infection eventuates in what is termed the "collar-button" or "collar-stud abscess" and receives this appellation because it is characterized by a superficial accumulation of pus in the palm connected by means of a narrow channel with a similar, and often larger collection in the deeper tissues. Oftentimes it will be noted that these collections of pus tend to burrow into the superficial tissues along the volar aspect of the proximal phalanges. A tremendous amount of edema is noted on the dorsum of the hand, but careful examination will reveal the absence of tenderness along the flexor tendon.

Treatment. Under local block anesthesia, infiltrating in a direction proximal to the infection in the palm, an incision is

Fig. 7. Collar-button or collar-stud abscess (subepithelial abscess), showing line of incision.

made through the web, extending into the palmar aspect of the hand through the true skin (Fig. 7). An artery clamp is then inserted into the lumbrical space, spreading the surrounding tissues, thereby releasing a large amount of pus which is out of all proportion to the preconceived size of the abscess from a mere view of the superficial inflammatory area. There is moderate bleeding occasionally from the digital vessels, but this is readily controlled by packing with a strip of dry gauze. The wound is then dressed; wet dressings are not applied until twenty-four hours later owing to the possibility of exciting bleeding by the hygroscopic action of the dressings. The gauze is removed in two or three days. Wet dressings are continued for a few days longer, and then a mixture of balsam of Peru and castor oil is applied to the wound to stimulate the growth of granulation tissue. Healing is complete in about two weeks (Fig. 7).

4. *Furuncles and Carbuncles.* Furuncles and carbuncles usually occur on the dorsum of the hand or on the fingers, and do not

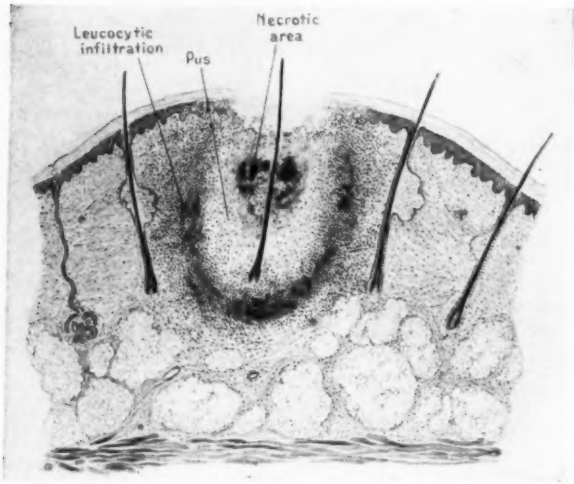


Fig. 8. Diagram showing carbuncle; *a*, pus; *b*, neurotic area; *c*, leucocytic infiltration.

differ in any respect, clinically or pathologically, from similar infections in other parts of the body. Frequently, however, they do not receive the radical treatment indicated and a long period of convalescence is the result. Infectious material finds entry by way of the hair follicle and its contiguous sebaceous gland, or directly through the sweat gland, thereby causing an infection in a column of fat which spreads to the deeper layers of the subcutaneous tissue and then laterally to the adjoining fat columns, through which path it reaches the skin. A considerable area of the subcuticular tissues, in this manner, becomes honeycombed with abscesses. One may observe the initial focus coming to the surface, giving the impression of a furuncular infection. A simple differential point in the determination whether one is dealing with a carbuncle or a furuncle is that around the central necrotic zone a secondary one of infection appears, with small, sieve-like openings in the skin which give the appearance of numerous furuncles discharging small quantities of pus, and away from the immediate area, one of brawny induration is noticeable, the roof of the central necrotic area. This is bounded by a leucocytic zone of infiltration (Fig. 8).

When dealing with a simple furuncle it generally suffices to avulse the hair with its follicle to provide adequate drainage. Furuncles should never be squeezed because the pus from a single furuncle may readily be forced into neighboring columns of fat, thereby converting a minor infection to a more serious one, the carbuncle.

Treatment. For the simple furuncle, then, avulsion of the air usually suffices. If wet dressings are applied, the infection usually resolves in three to five days, without avulsion of the hair and its root. The pain and discomfort are, of course, out of all proportion to the actual size of the infection.

Carbuncles require adequate drainage by crucial incisions beyond the tertiary zone of inflammation, undermining of the resultant four flaps and the removal of necrotic masses. Care must be observed to keep the incision and the dissection superficial to the underlying tendon sheath, for between it and the nethermost area of the carbuncle there is a leucocytic zone of infiltration which acts as a defensive barrier. The careless use of a scalpel without proper visualization may injure the tendon sheath and cause a fulminating infection. After the excision of the central necrotic mass, the gaping wound is packed with gauze which is removed in about three days. There is usually little or no bleeding. Ligation of blood vessels is generally unnecessary. Troublesome bleeding is checked by firm gauze packing sewn over the skin flaps with single sutures and made to serve as a hemostatic tampon. Repacking of the wound after the three-day interval is unnecessary because drainage usually continues and sloughing areas are easily removed with forceps or scissors. It is poor surgery to excise a carbuncle in its entirety because a large raw area necessarily results requiring skin grafting.

5. *Cellulitis with Subcutaneous Abscess Formation.* This condition usually complicates a superficial infection such as a furuncle, for example. The infection, instead of partial localization in the skin, as in carbuncles, spreads diffusely into the

subcutaneous tissues and forms a localized abscess. This does not, as a rule, involve the tendon sheaths or tendons primarily.

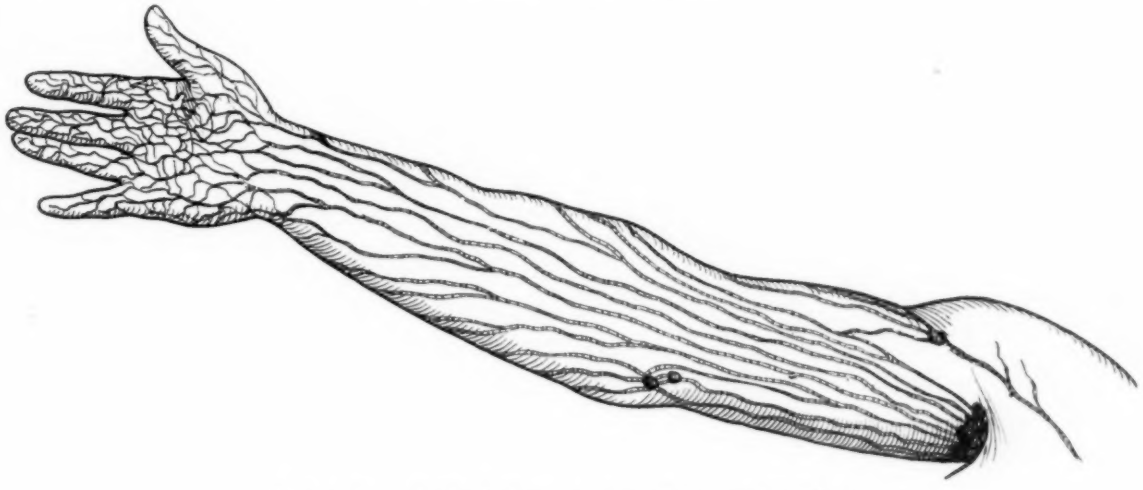


Fig. 9. Lymphatic drainage system of upper extremity.

But improper surgical treatment with the careless use of the scalpel may introduce the infection into the deeper tissues.

The *treatment* consists in the thorough evacuation of the abscess by careful incision through the skin and gentle separation of the deeper tissues with an artery clamp. This may be done under local block anesthesia. If the abscess is extensive, the patient should be hospitalized. This condition should not be confused with a cellulitis which occurs secondary to a perforating tenosynovitis or a thenar, hypothenar or midpalmar space abscess. These infections should be classed as major surgical ones.

CONCLUSIONS

A thorough knowledge of the surgical anatomy of the hand is an absolute imperative in the treatment of its various injuries and infections. Such knowledge assures a more correct evaluation of the gravity, and consequently, of the probable course of a given case.

The hand is the most anatomically complex mechanical bodily member and as such demands profound attention, ameliorative or curative, for functional, economic and esthetic reasons.

We have adverted to infections around the nails and the determination of their extent, gravity, and proper treatment; to felons or terminal closed space infections with, at times, difficult elicitation of fluctuation and the necessity of early incision properly placed; to collar-button or collar-stud abscesses in which, because of the loose character of the areolar tissue in and about the lumbrical muscles, infections spread rapidly to adjacent mechanically vital structures; to furuncles and carbuncles; to cellulitis and to subcutaneous abscess formations in which a correct diagnosis and use of the scalpel are essentials.

REMOVAL OF FISH HOOK EMBEDDED IN FINGER

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THIS injury is sufficiently prevalent to be worthy of consideration. The most important points in the treatment of this condition are prophylactic care and avoidance of unnecessary trauma to the tissues in its removal.

A large proportion of the infections of the hand follow trivial injuries such as those caused by the fish hook. Most of these infections could be prevented by efficient first aid, which includes forcing blood out of the wound, prompt application of tincture of iodine, merthiolate, or other such effective antiseptics, removal of the foreign body aseptically and immobilization when in doubt.

With increasing experience we have come to lay greater stress on careful thorough cleansing of the wound with soap and water, and abstinence from the use of powerful and irritating antiseptics, because of the destructive action of such antiseptics on exposed and non-resistant tissue cells.

If grease and dirt cannot be removed by soap and water; ether, benzene or some other fat solvent may be used, followed again by soap and water, after which, tincture of merthiolate is applied to the injured digit.

The area involved is infiltrated with local anesthetic, my preference being butyn-epinephrine solution ¼ per cent, the advantage being immediate and prolonged anesthesia as well as a minimum of toxicity. If the fish hook is firmly and deeply embedded in the underlying tissues, the best procedure in my hands has been to puncture the skin at the point of the fish hook if palpable, either with the point of the hook itself or by a small stab incision with the scalpel allowing the point of the hook to emerge sufficiently to cut the hook on the shaft proximal to the barbs using a wire cutter or bone cutting forceps for this purpose. The hook then being withdrawn through the point of entrance, a 50 per cent alcohol and boric dressing is applied and kept moist while there is any evidence of tenderness or pain. Incision should be made laterally when practicable, to avoid injury to the tendons and tendon sheaths to avoid possible tenosynovitis and away from the joint space to avoid trauma and possible infection into the joint itself. Where infection with tetanus bacilli is possible this should be anticipated by the administration of tetanus antitoxin at the time of the surgical procedure. The possibility of infection with the organism of gas gangrene must likewise be kept in mind and the wound examined daily for such infection, when feared.

POLYDACTYLISM

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POLYDACTYLISM is the occurrence of more than the usual number of fingers or toes in any animal, such as poultry, in cattle, and in sheep, as well as in humans.[1–8] It is frequently associated with syndactylism, which is the occurrence of a web-like growth between the fingers or toes.

Supernumerary fingers and toes have been observed and numerous articles written about them but up to date no definite etiology has been found. The condition seems to be best explained upon a hereditary basis in which the dominant Mendelian characteristic is that of polydactylism.[2,5,10,12] In 1866, Lawrence and Moon described a group of patients all suffering from similar symptoms, and since then such symptoms constitute what is known as a Lawrence-Moon-Biedl syndrome. In 1922 Biedl called attention to the presence of polydactylism in many of these cases. In 1929 Harvey G. Beck reviewed 35 reported cases of the Lawrence-Moon-Biedl syndrome, but offered no further information on the polydactylia phase. In a series of 64 descendants of an original effected parent, 27 were affected, 33 unaffected, and 4 doubtful.[11]

This condition is found among the peoples of practically every country and is no more prevalent in males than in females. It affects the fingers more frequently than the toes. The supernumerary digits are usually marginal, undeveloped, and lacking in a corresponding metacarpal bone.

The cosmetic effect usually brings the patient to the doctor, but occasionally the impediment that the supernumerary digit causes while the patient is at work or the difficulty of getting shoes to fit when the affliction occurs on the foot, is what causes a physician to be consulted.

Many varieties exist, ranging from the simple one phalanx, off-shoot type, to the complicated osseously combined type complicated further by syndactylism and supernumerary metacarpal or metatarsal, as the case may be.[12]

The diagnosis is obvious, but before satisfactory treatment may be given, the physician must make a careful roentgenological study of the extremity in order to be sure which digit is supernumerary as well as to discover any accompanying complication. Treatment consists of the surgical disarticulation of the extra digit in such a way as to leave the least offensive scar from the cosmetic as well as the utilitarian viewpoint.

SUMMARY

Polydactylism is a hereditary condition.
The diagnosis is obvious.
The treatment is surgical.

REFERENCES

1. VATTI, G. Polydactylia—cases in domestic animals. *Boll. d. Soc. eustacbiana*, 26: 1–20 (March) 1928.
2. GRENE, L. Polydactylia in horses and pigs. *Deutscbe Tierarztl. Wcbnscbr.*, 36: 348 (May 19) 1928.
3. WILSON, H. M. Clydesdale foal's supernumerary digits. *Vet. Rec.*, 7: 577 (July 2) 1927.
4. BOAS, J. Z. V. Polydactylia in horse. *Zool. Jabrb. Abt. f. Anat.*, 51: 313–322 (Nov. 6) 1929.
5. KOEHLER, O. Heredity of supernumerary fingers. *Biol. Zentralb.*, 49: 705–717, 1929.
6. SEIFERLE, E. Atavism and polydactyly of hind paws of dog. *Morpbol. Jabrb.*, 57: 313–380 (Jan. 25) 1927.
7. DRAHM, F. Polydactylia in horses. *Berl. tierarztl. Wcbnscbr.*, 43: 94 (Feb. 11) 1927.
8. PANNET, R. C., and PEASE, M. S. Polydactylia genetic studies in poultry.
9. NYLANDER, E. D. Pre-axial polydactylism in five generations of Swedish family. *Upsala lakaref forb*, 36: 275–292 (May 22) 1931.
10. MCCLINTIC, B. S. Five generations of polydactylism. *Normal heredity*, 26: 141–144 (April) 1935.
11. MANSON, F. S. Hereditary syndactylism and polydactylism descriptive of recent additions to pedigree. *Brit. Med. Jour.*, 2: 1044 (Dec. 8) 1934.
12. SCHATZKI, P. Concealed syndactylic polydactylia and triangle formations in human metacarpus. *Arcb. Ortbop.* (Jan.-March) 1936.

TREATMENT OF VARICOSE VEINS AND ULCERS*

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THE author's impressions are based on an extensive experience with the treatment of varix and ulcer cases, which has come largely from the Varicose Vein Clinic of the Long Island College Hospital and a considerable number of private patients, totaling over 25,000 individual treatments.

Patients as well as doctors repeatedly ask the question "What is the cause of varicose veins?" It can be answered in all frankness that we do not know. To put an end to further questioning, we have always added to this statement that the dilatation is due to a condition of the wall of the vein in which a congenital or an acquired weakness has permitted the intravenous pressure to distend the vessel gradually.

In the treatment of varices of the legs we record the state of the dilatation in degrees, for practical purposes using "moderate" and "severe," with a description of the distribution of the lesion. This point is raised because it is much more satisfactory to treat the moderate case rather than the one in which the veins have attained the size of a garden hose.

The ulcer which occurs as a by-product of varicose veins, is a common experience and it is usually situated on the lower inner aspect of the leg but may be in any portion of the foot or leg above the plantar pad. They vary greatly in size, duration and in the amount of infection in the surrounding tissue. With the infection from the ulcer we get the damaging of the lymphatics and the accompanying edema; for this reason the ulcer in the edematous leg often appears exaggerated above what it actually is. It is like the picture of the elephant on the child's balloon; when the balloon is distended the elephant is big, but when the balloon is deflated the elephant is diminutive.

In the literature one often finds objections to sclerosing veins in pregnant women. In order to demonstrate to our own satisfaction the fallacy of the objection we have deliberately sclerosed veins during pregnancy with no accidents from this procedure. Despite this experience, however, we no longer inject the veins in pregnant women because we believe that we are not able during pregnancy to determine definitely what veins will be collapsed after delivery as the dilated veins have a remarkable faculty of disappearing in a large part after delivery. A purely personal factor may also enter into this conclusion. We hold that a woman in the process of preparing a fetus for delivery should not be hampered by any therapy whatever which might be considered elective.

The individual who is suffering from any systemic disease through which he has been rendered an invalid whether it be heart, lungs, kidney, or any other organ, is not a fit subject for therapy. In reference to all other contraindications to therapy we have seen fit to ignore them.

The treatment of varicose veins today has been removed from the operating room; it is no longer considered necessary or advisable to excise varices. This does not mean necessarily that the removal of the offending veins is not desirable, because it is. The disability, hospitalization and loss of time by the operative method, as well as the increased mortality risk to the patient from the procedure, has forced the acceptance of sclerosis in varicose veins as the preferable method of treatment. Many substances have been recommended for the production of the sclerosing effect; doubt-

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less many of those that we do not mention have great virtue. We have experimented with most of them and for reasons which seem to us proper, we have discarded all except sodium morrhuate 5 per cent and sodium chloride 36 per cent. The morrhuate rarely causes pain at the time of injection; occasionally, after the injection the patient will complain of a severe pain in the region of the lower spine, which lasts five or ten minutes. Apparently this back pain when once it occurs is repeated at every subsequent injection but we have seen no harm come from it. Morrhuate will sometimes give rise to a skin eruption which may cover the entire body or parts of the body and is associated often with edema of the face. It is without doubt anaphylactic in origin; someone has euphemistically termed it morrhuism.

We inject our patients in the standing or sitting position. We use a small needle of No. 22 or 24 gauge. After the material is injected a pledget of alcohol gauze is left over the puncture wound and pressure is maintained for three minutes at the point, the object being to restrict an intensive action of the reagent to a limited area. Despite this precaution, however, we often have this experience; an injection given in the leg gives rise to a sclerosis of the veins of the thigh. In two or three days the sclerosed vein should be both tender and painful, but this wears off. In another day or so the patient is left reasonably comfortable. No disability as regards occupation occurs. Occasionally the extent of the sclerosis of the vein is much greater than was planned and the perivenous infiltration will be 5 or 10 cm. in extent and the entire area so hot, red and painful as to render the patient unable to pursue his occupation for a few days. We have found that a supporting bandage to such an extremity is a great comfort to the patient. It will often permit him to be up and about and perhaps follow his work with a reasonable degree of comfort. During these severe reactions a moderate degree of fever is observed. Although a number of deaths have been recorded in the literature from the sclerosing treatment of veins, to our knowledge we have not as yet had such an experience.

An individual who has had varicose veins is suffering from a congenital or an acquired condition which for practical purposes is progressive. Because today we remove by excision or sclerosis one group of offending veins is no guarantee that the individual is protected from the occurrence of other varices. We have reviewed our older cases sufficiently to see extensive varices recurrent alongside of fibrous cords which are the remnants of the old sclerosed veins. It is better to forewarn patients that with the recurrence of any varices the treatment should be administered early when the varices are small as it is much easier to sclerose smaller veins than larger veins.

Despite the purpose in the physician's mind in the treatment of varices, many patients come for a motive which is perhaps not so serious. Personal vanity and cosmetic effect enters largely into the determination of the female to rid herself of these disfigurements. Following the sclerosis by some solutions there is a pigmentation of the skin which occurs along the course of the vein; this we have seen repeatedly. It may happen even with the materials we have recommended, but it is believed that it is least likely to occur when these solutions are employed.

Failures by the sclerosing treatment have occurred in our experience from time to time. Some individuals have been injected with every solution in our armamentarium, in every position and by every technique, with no result. Such individuals have a resistant venous intima; one can explain the failure to sclerose in no other way. We have usually closed this disappointing chapter by giving such patients external support. Fortunately, the incidence of these experiences is less than 1 per cent.

The acute phlebitis of infectious origin which occurs frequently in the natural course of events in varicose veins has been treated for generations, one might say, in the conventional manner of rest and eleva-

tion. Because of our experience with artificial chemical thrombosis, we feel by analogy that the infectious thrombosis should be treated by the same ambulatory method. For several years we have practiced support by elastic bandage and mobilization of the patient for bacterial phlebitis of the lower extremity, as soon as the acuteness of the pain would permit that to be done. We have had no accidents or unusual experience as a result of this innovation. The patients, we believe, have been returned to useful activity after a much shorter period of time than was formerly the case.

From time immemorial the ulcer of varicose origin has plagued mankind. The father of medicine, Hippocrates, made the observation that rest in the horizontal position would cure these lesions; modern times has added a host of antiseptics to our therapy. For all these antiseptics and their greasy vehicles we have but one thing to say and that is to condemn them. In the growth of the struggling epithelial cells from the margin of the ulcer there is no pabulum that equals the juices of the body. To administer a cocktail of a mercurial or phenol derivative to struggling epithelial cells is detrimental and can be only detrimental.

The principle of support, achieved by means of a circular elastic bandage, is the procedure we employ. In order to seal the discharges from the wound this bandage is covered on one surface by neutral rubber, latex, in semi-liquid form. This bandage when applied is left in position for several days. The juice that accumulates between the latex and the granulation tissue will be found to be sweet, with little if any odor. Microscopic study will show detritus of disintegrated cells and a scattering of Gram-positive and Gram-negative organisms. Laboratory work on this juice has shown that it contains bacteriophage. The absence of putrefaction would seem to indicate that there are other bacteriolytic substances present. In this juice the epithelial cells grow well and rapidly, the healing time depending upon the size of the ulcer. In that group of individuals with an associated deep and long standing infectious process, the healing of the ulcer is slow of accomplishment. We find that this is especially true of those individuals of short life expectancy; these patients would be better off hospitalized.

Undoubtedly burden bearing enters largely into the cause of varix and ulcer. People so afflicted are least able to bear extra loads of any kind; overweight has been noted with great regularity, both men and women being victims of this excessive poundage, especially women. Childbearing, overeating, endocrine dysfunction and enforced inactivity from disability all enter into a story told by the scales. One confers a real blessing on these people by correcting their overweight; repair of the veins and healing of the ulcer is hastened and the tendency to recurrence of lesions is greatly reduced. The benefit to the entire body from the reduced amount of work that it has to do each day is definite. Every somatic cell gets a new lease of life. Dieting is a hard struggle but the victory justifies the battle.

CONCLUSION

It might be said that we have a simple, safe and rational method for the treatment of varicose veins which has passed well beyond the experimental stage and accomplishes the most rapid and comfortable healing. Also we have a method for the treatment of phlebitis, whether of chemical or bacterial origin, which accomplishes the curing of the patient with greatly reduced disability.

CLINICAL COMPARISON OF SCLEROSING SOLUTIONS IN INJECTION TREATMENT OF VARICOSE VEINS

DELAYED SLOUGH; RECURRENCE OF VARICES

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ALTHOUGH the efficacy of the injection treatment of varicose veins has been definitely established, I have been repeatedly questioned by physicians regarding the proper sites to begin injecting, the type of solution to use, the possible dangers involved, and the results that can be expected. It was the impression of many that the injection of veins in the upper thigh is contraindicated. The literature also leads one to believe that certain sclerosing solutions are non-toxic systematically and never produce sloughs locally, thereby making these solutions the most ideal. The written reports also lead one to expect a high percentage of recurrences. Since my observations over a number of years do not confirm these impressions, I feel that a résumé of my findings is warranted. In addition, I should like to describe what I call a "delayed or postobliterative slough," a finding which I believe has not been reported. The cases supplying the data for this paper were treated both in the Varicose Vein Clinic at the Brooklyn Jewish Hospital, a branch of Dr. B. Wolfort's Orthopedic Clinic, and in my private practice.

GENERAL FACTORS INFLUENCING INJECTION TREATMENT

It is a known fact that many patients and even some physicians still regard the injection treatment of varicose veins with suspicion and advise against the procedure. This is due to the immediate or delayed local pain, the systemic reaction due to drug idiosyncrasy, the occurrence of sloughs, and the supposedly high incidence of recurrences. The general and local factors that determine the success or failure of this form of treatment have been repeatedly reported, and need only to be enumerated. Until recently the two main contraindications to the injection treatment have been an inefficient circulation through the deep venous system, and an acute superficial phlebitis.

Postobliterative Infectious Phlebitis. In the past few years I have noted that active foci of infection, even distantly removed, have produced extensive painful obliteration in the veins injected. It is therefore important to postpone injections in patients suffering from upper respiratory infections or other active foci. It is also important for patients who have already had their veins obliterated to guard against all types of respiratory infections. I have had several cases in which a typical infectious phlebitis has been superimposed upon a chemically obliterated vein an invariable length of time following its injection. In 2 of these cases, the patients developed a sore throat and rhinitis just prior to the onset of the phlebitis. In a third case an influenzal bronchitis was present. The veins had been chemically sclerosed from two to six weeks before. It is evident that the recent phlebitis could not have been chemical in origin, but must have been infectious in type, metastatic in origin. This I have termed "postobliterative infectious phlebitis." This is different from the severe, painful phlebitis which occurs within a few days after the injection of a vein in which a latent subclinical phlebitis existed. Tests to determine latent phlebitis have been described in the literature. When these

are positive, injections should be given cautiously and in small amounts. In the cases of postobliterative phlebitis, there had practically subsided, she was given a second injection of only 2 c.c. of morrhuate. The generalized rash again appeared,

Fig. 1. Type of thin-walled vein likely to produce a delayed slough.

Fig. 2. Same vein three weeks later; note glossy, tense appearance. Delayed slough subsequently formed.

were no evidences of a pre-existing latent phlebitis.

Drug Idiosyncrasy, Morrhuism. Another general factor detrimental to the injection treatment is the individual idiosyncrasy to various drugs employed. The accompanying table indicates that of the more common solutions employed, untoward generalized reactions are common with sodium morrhuate, quinine hydrochloride and urethane, and sodium salicylate. I have never yet seen any general reaction following the use of sodium chloride. After the use of sodium morrhuate, several patients developed gastrointestinal upsets with nausea and vomiting. One patient received 3 c.c. of sodium morrhuate and the following day a pruritic rash covered her entire body and scalp. Exfoliation occurred later which lasted more than three weeks. About one month after this injection, when the desquamation although less marked than previously. The remaining veins were treated with sodium chloride with no untoward effects.

Cinchonism. Cinchonism following the use of quinine hydrochloride and urethane has been described in a previous publication. Although ampoules of 2 c.c. are put on the market, I advise against the use of more than 1 c.c. of the drug at one sitting. Dizziness, ringing in the ears, palpitation and gastrointestinal upset have occurred in some of my cases. I have heard of cases of syncope and 2 cases of exitus following its use. I once employed quinine in the treatment of an interne who had innumerable fine thin walled veins. On many occasions from 0.5 to 1 c.c. of the drug was injected with no systemic reaction. Upon the insistence of the interne that larger doses be given in order to hasten the results, I employed 1.5 c.c.

Fig. 3. Another thin walled vein which later formed a delayed slough.

Fig. 4. Delayed slough occurring almost five months after injection.

A B

Fig. 5. Case 1. Before treatment; A, note large pendulous sac filled with veins; B, lateral view.

of the solution. He immediately developed dizziness and general weakness and was confined to bed for the rest of the day.

A B

Fig. 6. Case 1. After treatment; A, sac only partially contracted; B, appearance following skin plastyic.

Quinine is contraindicated during the menses since it may produce menorrhagia. I have had 2 cases where quinine initiated the menstrual flow prematurely.

Salicylism. Salicylism has occurred in several of my cases following the injection of 20 to 40 per cent sodium salicylate. In addition to a gastrointestinal upset, a generalized rash has been noted on a few occasions.

The disadvantages of the remaining solutions are recorded in the chart. From the general viewpoint, therefore, it is my belief that sodium chloride is the best and least harmful drug at our disposal. It is important to note, however, that the ideal drug has not as yet been found. The three drugs mentioned above cannot be considered ideal because of the possibility of individual idiosyncrasy to them. The remaining solutions including sodium chloride are ruled out as being ideal because of the local disadvantages to be enumerated.

LOCAL FACTORS INFLUENCING INJECTION TREATMENT

It should be understood primarily that any drug which is caustic enough to destroy the intima of a vein to produce occlusion, is strong enough to destroy perivenous tissue and produce a slough when injected outside the vein. The reported claims that quinine and morrhuate do not produce sloughs is unwar-

ranted. I have intentionally injected small amounts of every solution subcutaneously and have in each instance produced a slough. Any solution which will not produce a slough when injected perivenously will generally not be strong enough to obliterate a vein. It is folly therefore to look for the ideal solution which never produces a slough. The physician must realize that early sloughs can only be avoided by proper, meticulous technique.

An ideal solution must be one that produces no pain or cramp, is generally non-toxic, and one which causes effective obliteration. According to this definition, none of the drugs in common use is ideal. If the cramp following the injection of sodium chloride could be eliminated, I should consider it an ideal solution. Although sodium morrhuate, quinine hydrochloride and urethane, and sodium salicylate are eliminated as ideal because of the possibility of idiosyncrasy to them, they also fall short because of possible untoward local reactions. Sodium salicylate generally produces a cramp which is more painful than that of any other drug. Although sodium morrhuate generally does not produce an immediate cramp, it does often cause a severe burning, stinging or lancinating pain which begins several minutes after the injection. This pain may last from an hour to several days and often confines the patient to bed. In a busy clinic it is easy for the physician to lose sight of this delayed reaction. The patient has usually left the clinic, and the pain may come on while she is on her way home. At the following visit no inquiry is made regarding any interval discomfort since there was no immediate pain following the last injection. Quinine seldom produces any cramp, although occasionally a patient may complain of mild pain. It does, however, often produce a bronzed discoloration of the skin at the site of injection. This discoloration may last for over two years. In addition, quinine may produce what I have termed a "delayed or postobliterative slough."

Postobliterative or Delayed Slough. A postobliterative slough is one which occurs from one to several months after the injection of a thin walled vein. This vein may be large or small, but it is usually thin walled. Occasionally it may occur in a thick walled vein into which too much solution was injected. It occurs even though the technique of injection is perfect. The solution not only destroys the intima but also the atrophied media and adventitia of the vein wall. Following the injection the vein becomes obliterated and tender. The skin over it may become red, warm and glossy. The destruction gradually advances until after several weeks a slough occurs. With experience, these thin walled, superficial veins that are likely to produce delayed sloughs can be predetermined. Figure 1 presents such a vein on the posterior upper aspect

Fig. 6. c, lateral view.

of the right calf. Figure 2 shows the same vein three weeks after obliteration. The vein is shiny and tense. This site later broke down. Figure 3 illustrates another such vein on the anterior upper aspect of the left leg. This case also developed a delayed slough. Figure 4 is an example of a delayed slough. A thin walled vein was injected with 1 c.c. quinine hydrochloride and urethane on March 31, 1930, and the slough appeared. On August 25, 1930.

A B

Fig. 7. Case 11. A, before treatment; B, lateral view. Note ulcer at inner left ankle; prominent, thin walled vein on middle third of left calf formed a delayed slough.

It is important to note that these delayed sloughs are not due to injection of the solution perivenously. When extravasation occurs at the time of injection, the slough forms much earlier. The latter is immediately evidenced by a bluish white discoloration surrounded by a red areola, a sign described in a previous publication. In the delayed slough cases no such sign appeared, not even did any superficial blister form. Counter-injection with distilled water or 0.5 per cent novocaine solution will prevent the early sloughs but will have no effect upon the delayed slough cases. In my experience quinine has been the chief offender in producing these delayed sloughs. Morrhuate is second although far behind. Any solution presumably can produce these delayed sloughs, although I have only seen them following the use of quinine and morrhuate. In order to avoid these sloughs, milder solutions should be employed when injecting fine veins. I have never seen this complication when 15 per cent sodium chloride solution was used in small doses. Considering the above factors, therefore, it is my belief that sodium chloride is the best solution even from the local stand-

point. If the cramp accompanying its injection could be eliminated, it would be quite ideal. Nevertheless, the cramp is never as severe as that following the injection of sodium salicylate. In addition, patients who have received both the chloride and the morrhuate injections have expressly preferred the momentary cramp of the chloride to the long, drawn-out pain of the morrhuate.

A B

Fig. 8. Case 11. A, after treatment; B, lateral view; ulcer is healed; note delayed slough.

Recurrence of Varices. The opinion that varicose veins recur in the majority of cases is unfounded. I have seen many cases who have received from four to eight injections and who were discharged as cured. The larger and more conspicuous veins were injected, but many smaller visible veins were left untreated. In addition, many untreated invisible veins could be palpated beneath the skin. The fact that these smaller veins enlarge in time and become prominent does not justify the diagnosis of recurrence. These cases were never treated thoroughly in the first place. Should treatment cease at this point, not only will the smaller veins enlarge but they will also tend to recanalize the few obliterated veins. On the other hand, we must admit that even those cases which are thoroughly treated may develop new varicosities in time.

The infra-red photographs have demonstrated that many veins are present subcutaneously which are neither visible nor palpable. The same etiological factors that originally produced the varicosis may also cause these veins to become enlarged. We know that certain individuals possess a varicose vein diathesis. Otherwise, under similar conditions, why should some people develop varicose veins and

others not? Why should varicose veins appear so regularly in certain families and not in others? Since a good proportion of patients with varicose veins display this tendency, we must expect recurrences in them. But these will not appear so rapidly if the original treatment is done more thoroughly. It is important to obliterate the main trunk of the internal saphenous in the thigh if early and extensive recurrences are to be avoided. Often this vein is not visible, but it is usually palpable and can easily be injected. After treatment is completed, I advise my patients to return for inspection every six months, during which time only a few, if any, new veins may be present.

A B

Fig. 9. Case III. A, before treatment; B, after treatment.

CASE REPORTS

The impression that the injection of varicosities in the upper thigh is dangerous is disproved by the report of the following cases.

Case I. A forty year old woman had enlarged veins distributed over the right thigh and leg and a large pendulous sac filled with veins at the level of the saphenofemoral junction. After twenty-four injections the veins were entirely obliterated. Following the disappearance of the veins the pendulous sac near the groin only partially contracted. A skin plastic was therefore performed under local anesthesia.

Case II. A fifty-four year old woman presented large saccular veins over the right thigh and both legs and an ulcer over the inner aspect of the left ankle. On the middle third of the left calf will be noted a prominent, shiny, thin walled vein, the type in which a delayed or postobliterative slough may occur. This patient required ninety-six injections to obliterate all her veins. The ulcer was treated with metuvit ointment and elastoplast bandage, as described previously. A delayed slough developed several months after the thin walled vein was sclerosed.

Case III. A middle-aged man with large saccular veins over the right thigh and leg.

The dark area on the inner mid aspect of the leg is due to an old injury and has no relation to the varicosities. Twenty-four injections were required to occlude these veins.

CONCLUSIONS

Although the ideal solution has not been found as yet, sodium chloride still ranks as the best choice. Any solution that is capable of sclerosing a vein can also produce a slough. Early sloughs can be avoided by proper technique. Delayed or postobliterative sloughs occur in thin walled veins even though the technique of injection is perfect, but they can be avoided by using weaker solutions and smaller doses. Early and extensive recurrences of varicosities can be avoided by more thorough treatment.

CLINICAL COMPARISON OF SCLEROSING SOLUTIONS

Solution	Amount	Advantages	Disadvantages	Indications for Use	Length of Vein Obliterated	Occlusion Time
1. 15–30 per cent sodium chloride.	½–10 c.c.	Non-toxic, good obliteration, prompt action	Cramp, danger of necrosis	In all types of veins	Varies with individual venous sensitiveness	Varies with individual venous sensitiveness
2. 5 per cent sodium morrhuate.	½–5 c.c.	Seldom cramps, good obliteration, prompt action	Necrosis, local burning generalized rash, g.i. upset	In all types of veins; test for susceptibility	Affected by latent phlebitis	Different veins in same individual may obliterate quickly or slowly
3. Quinine hydrochloride and urethane.	½– 1 c.c.	Seldom cramps, good obliteration, prompt action	Necrosis, cinchonism, starts menses, discolors skin	Small veins; test for susceptibility	Average length of occlusion is 1–3 inches	
4. 20–40 per cent sodium salicylate.	½– 5 c.c.	Good obliteration, prompt action, relieves arthritic pain	Marked cramp, necrosis, salicylism	Resistant veins used combined with chloride	.....	Average time to occlude all veins 10 weeks
5. 50–75 per cent invert sugar.	2–10 c.c.	Slight cramp	Necrosis in diabetes, too viscous	Large veins non-diabetic	.....	Average number of injections—20
6. 50 per cent dextrose...	2–10 c.c.	Slight cramp	Necrosis in diabetes, action weak	Smaller veins combined with 30 per cent NaCL		
7. Varicosmon.....	2–10 c.c.	Seldom cramps	Necrosis; too viscous	Large veins		

REFERENCES

1. Carter, R. M. The injection treatment of varicose veins. *Am. Jour. Surg.*, 8: 551, 1930.
2. Colt, G. H., Ramsay, I. S. W. and Morrison, N. Injection treatment of varicose veins: late results; question of recurrence. *Brit. Med. Jour.*, 2: 49, 1935.
3. deTakats, G. Injection treatment of varicose veins: causes of failure. *J. A. M. A.*, 96: 1111–1114 (April 4) 1931.
4. Howard, N. J., Jackson, C. R. and Mahon, E. J. Recurrence of varicose veins following injection. *Arch. Surg.*, 22: 353, 1931.
5. Jacques, L. Varico-phlebitis and the injection treatment. *Ann. Surg.*, 95: 746–753 (May) 1932.
6. Jensen, D. R. Varicose veins and their treatment. *Ann. Surg.*, 95: 738, 1932.
7. Lewis, K. M. The injection treatment of varicose veins. *Ann. Surg.*, 95: 727, 1932.
8. McPheeters, H. O., Merkert, C. E. and Lundblad, R. A. The injection treatment of varicose veins: causes of failure. *J. A. M. A.*, 96: 1114–1117 (April 4) 1931.
9. Payne, R. T. Infra-red photography of superficial venous system. *Lancet*, 1: 235, 1934.
10. Schmier, A. A. Sclerotizing injections in varices of the lower extremities. *J. A. M. A.*, 94: 1222, 1930.
11. Schmier, A. A. Treatment of varicose ulcers. *Am. Jour. Surg.*, 23: 195, 1934.
12. Tunick, I. S. and Nach, R. Sodium morrhuate as a sclerosing agent. *Ann. Surg.*, 95: 734, 1932.
13. Tunick, I. S., Dubin, S. and Schmier, A. A. The injection treatment of varices and ulcers of the lower extremities. *Am. Jour. Surg.*, 6: 479, 1929.

AMBULATORY SAPHENOUS LIGATION

REPORT OF 100 CONSECUTIVE CASES*

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IN the treatment of varicose veins, ligation of the saphenous vein in the thigh has gained a definite place of importance, in those cases where the valves of the long saphenous vein have become pathological and fail to function. Because of this fact, there is a backflow of blood in the vein toward the foot, due to the erect position of the body and caused by gravity. It is thought that some varicose veins may result solely from the insufficiency of these valves. In any event, in this condition there is a flow of blood down toward the foot, then through the communicating veins into the deep circulation, and up the deep femoral vein to the iliac vessels. As the long saphenous vein joins the femoral vein at this point, and because of valvular deficiency, some of the venous blood may again enter the saphenous vein and descend toward the foot, reaching the deep circulation once more through the communicating veins. If such a cycle is considered in toto, it is apparent that all of the blood does not continue toward the heart, some again completing the pathological circuit many times by dropping downward in the saphenous vein, causing back pressure, stasis and dependent edema. This type of pathology is known as Trendelenburg positive veins.

A similar pathological circuit is developed in the leg posteriorly, when the valves of the short saphenous vein fail to function. There is a backflow of blood at the point where the small saphenous vein joins the popliteal vein in the popliteal fossa. In the erect position, with Trendelenburg positive veins, there is a column of blood from the right side of the heart down through the inferior vena cava, the iliac vein, the femoral vein and finally the incompetent saphenous vein to the foot. This column of blood, because of its weight, exerts pressure against the wall of the saphenous vein and its tributaries, causing these veins to widen and become varicosed. It is the purpose of ligation of the saphenous vein to interrupt this column of blood, thereby removing its pressure on the varicosed veins below the level of ligation.

When the treatment of varicose veins by injection was revised and tried again a few years ago, a number of patients returned with recurrences after several months, following an adequate course of treatment. With these facts in mind, the mechanics of the circulation were studied, and ligation of the saphenous vein was added to the treatment in order to prevent the recanalization of veins thrombosed by injections. The recanalization took place as a result of the incompetence of the valves of the saphenous vein, and due to the pressure of the column of blood described.

After this fact was established, in this clinic ligations were taken up in conjunction with the injections as part of the routine treatment of this type of veins. At first the saphenous vein was ligated in the lower part of the thigh, but more experience showed that new veins would form and continue around the site of ligation, resulting in new varicosities or the return of some old ones. The ligation is now done in the thigh as high as possible, although it can be done no higher than the vein can be followed because the anatomical relationships are not constant. Some authorities advise routine ligation at the end of the long saphenous vein (i.e. just below Poupart's ligament), but we feel that such a procedure will lead to a certain percentage of failures because the vein occasionally drops into Hunter's canal below the fossa ovalis.

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This series of ligations was done in the out-patient department as we feel that hospitalization is unnecessary with the technique employed. This fact is important economically, as most of the patients treated in the clinic could not afford to leave their homes or to pay a hospital bill. They leave the clinic soon after the ligation and many or most of them have continued their day's work. Some have complained of tenderness for several days, and one or two only have had to be confined at home for several days.

The first ligation of this series was done in November, 1935, covering approximately a period of three years. Since the middle of 1934 nearly all the saphenous ligations have been high in the thigh. Those before that time were in the low or midthigh.

Table I shows the advantages of high ligation, as was learned from these patients on return visits at three and six months after completion of treatment. It will show the advantage of interrupting the circulation as high as possible in the thigh. Table II gives the summary of the location

Table I

Location	Number of Ligations	Number of Recurrences	Per Cent Recurrence
Lower thigh	10	3	30
Midthigh	29	12	41
High ligation	61	0	0

Table II

	Male	Female	Total
No. of Patients	15	47	62
Right thigh	12	47	59
Left thigh	6	35	41

and sex. It will be noted that 59 per cent of the ligations were performed in the right thigh. This is an interesting fact as varicose veins are supposed to be more frequent in the left leg, owing to the anatomical distribution of the iliac veins and causing higher pressure readings in the veins of the left leg. The ratio of female to male patients is about 3:1.

CLINICAL PROCEDURE

On admission to the clinic a complete history is taken of the patient's complaints, past medical and surgical history, paying special attention to the obstetrical, past injuries, phlebitis, typhoid, and family history. Knowledge of a past postpartum thrombophlebitis or milk-leg, typhoid, or severe injury may lead us to suspect deep venous involvement. The family history frequently reveals the presence of varicose veins in several members of the family as an hereditary tendency.

A complete physical examination is made, the urine examined, and a Wassermann test is made. Abscessed teeth and infected tonsils are ruled out as foci of infection for recurring phlebitis. Cardiac decompensation or chronic nephritis are excluded as the cause of edema of the lower extremities. A patient with diabetes will need to be controlled before treatment is started, but can be readily and safely treated after regulation has been accomplished. Pelvic examination may reveal an inflammatory exudate or tumor as a possible etiological factor in producing vein pathology. An allergic patient with varicose veins and a weeping eczema may have to be desensitized in combination with treatment of the veins. What appears to be a varicose ulcer may prove to be syphilitic and require some form of antiluetic treatment.

Diagrams are then made of the lower extremities, charting the location of varicosities, ulcers, pigmentation and edema, together with accurate measurements of differences in size of the legs. These diagrams are of assistance in following the progress of the case and in reviewing the original pathology in the future.

The veins are examined by means of the Trendelenburg tests to determine the type of varicose veins present and whether the deep venous circulation is involved. The cases for ligation are thus chosen on admis-

sion to the clinic and ligation is done before any other treatment is given, unless a dirty ulcer or infection is present. In such a case ligation is deferred.

The tests for Trendelenburg positive veins and involvement of the deep venous circulation are made in a practical way. If the valves of the saphenous vein are entirely incompetent (Trendelenburg positive), an impulse will be transmitted upward through the whole length of the vein by percussing the varicosities in the leg. With the patient standing, the prominent veins in the leg and thigh are percussed with the fingers of one hand, and the impulse that is transmitted upward may be palpated over the saphenous vein in the thigh with the fingertips of the other hand. In this way the course of the saphenous vein can be traced to its upper limit (in almost all cases at the fossa ovalis), and the position of the vein in the upper thigh located accurately. Similarly, an incompetent small saphenous vein in the posterior leg can be traced to the popliteal fossa.

The deep venous return is tested by placing a tight flannel bandage about the patient's leg from the toes to the knee. This is tight enough to constrict the superficial veins. If the deep venous circulation is occluded, the patient will experience some pain in the leg and foot in ten to fifteen minutes, together with swelling and cyanosis of the foot. The patient walks about with the bandage for several hours, and if comfortable, the deep venous circulation is considered competent. This precaution seems important, as 3 cases have been seen with deep venous occlusion. If deep venous involvement is found, then ligation or injection of the superficial veins is contraindicated, as these veins are compensatorily enlarged, and any radical treatment would only lead to edema, more varicosities, or possibly serious trouble. The treatment in such cases consists of rest, frequent elevation of the lower extremity, and support with an elastic bandage.

The patients return to the clinic for treatment at weekly intervals. After the course of treatment is completed, the patients return to the clinic for follow-up at the end of one month, then three months, and finally at six months intervals.

TECHNIQUE OF LIGATION

With the patient standing, the level of ligation is determined by percussing the lower end of the varicosed vein and palpating the impulse transmitted upward in the vein. The incompetent vein is nearly always the saphenous vein, although anomalous veins are occasionally found and ligated. The impulse can usually be traced to the fossa ovalis. The level of ligation is the highest point at which the impulse can be felt. In most cases this point is about 1 to 1½ inches below Poupart's ligament.

The level of ligation is marked with a stain on the skin overlying the vein, as the vein cannot be felt in the reclining position. This simple precaution will localize the vein and save much later hunting. The stain is applied in the form of a cross or plus sign, with the horizontal line denoting the level of ligation and the vertical line showing the long axis of the vein.

The patient then lies down on the table. The skin in the operative area is shaved. Iodine and alcohol are used on the skin.

Novocain solution 1 per cent is injected along the line of incision and a one inch long incision is made at right angles to the course of the vein, using the horizontal line of the stain as a guide. The subcutaneous fat is bluntly dissected with Kelly clamps. If the exact line of the vein has been determined, the vein will frequently be seen or felt beneath the superficial fascia. The vein is found lying superficial to the deep fascia. It is advisable to dissect slowly and carefully, and to use only blunt-nosed clamps, since the wall of the vein is frequently very thin or varicosed even at this level, and can be easily pierced or torn.

The exposed vein is carefully dissected from its bed and freed for about one inch. The vein is lifted out of its bed, doubly clamped, and cut between clamps. Care is taken to leave enough cut vein beyond the clamps to prevent the edge of the vein from slipping through the clamp. In obese pa-

tients, where the vein is under tension, the extra precaution is taken of tying the vein proximal to the clamps before it is cut, to preclude any possibility of losing the cut end. If lost, the cut end drops quickly out of sight, and requires much extra time and extreme care in recovering it without extensive blood loss. This complication occurred in one case previous to this series.

A ligature is tied proximal to the clamp as high as possible, and then a transfixion suture is placed between ligature and clamp, as shown in Figure 1, following the same procedure for both segments of the vein. The ligature and suture material is No. 1 plain catgut. The use of heavier catgut has been tried but was found to cause induration or sterile pus formation, due to the position of the vein in fatty tissue.

The wound is inspected for bleeding and then swabbed with ether in order to cut down as much as possible on possible contamination. It is not necessary to close the fascia or attempt approximation of tissues beneath the skin. The less catgut used beside the vein, the better. The skin is closed with horsehair in mattress sutures, without drainage. The wound is covered with gauze saturated with alcohol, and strapped tightly with adhesive strips about 8 inches long.

The patient is allowed to stand and walk about immediately, but is detained in the clinic for about half an hour, to be observed for weakness, fainting or any untoward reaction.

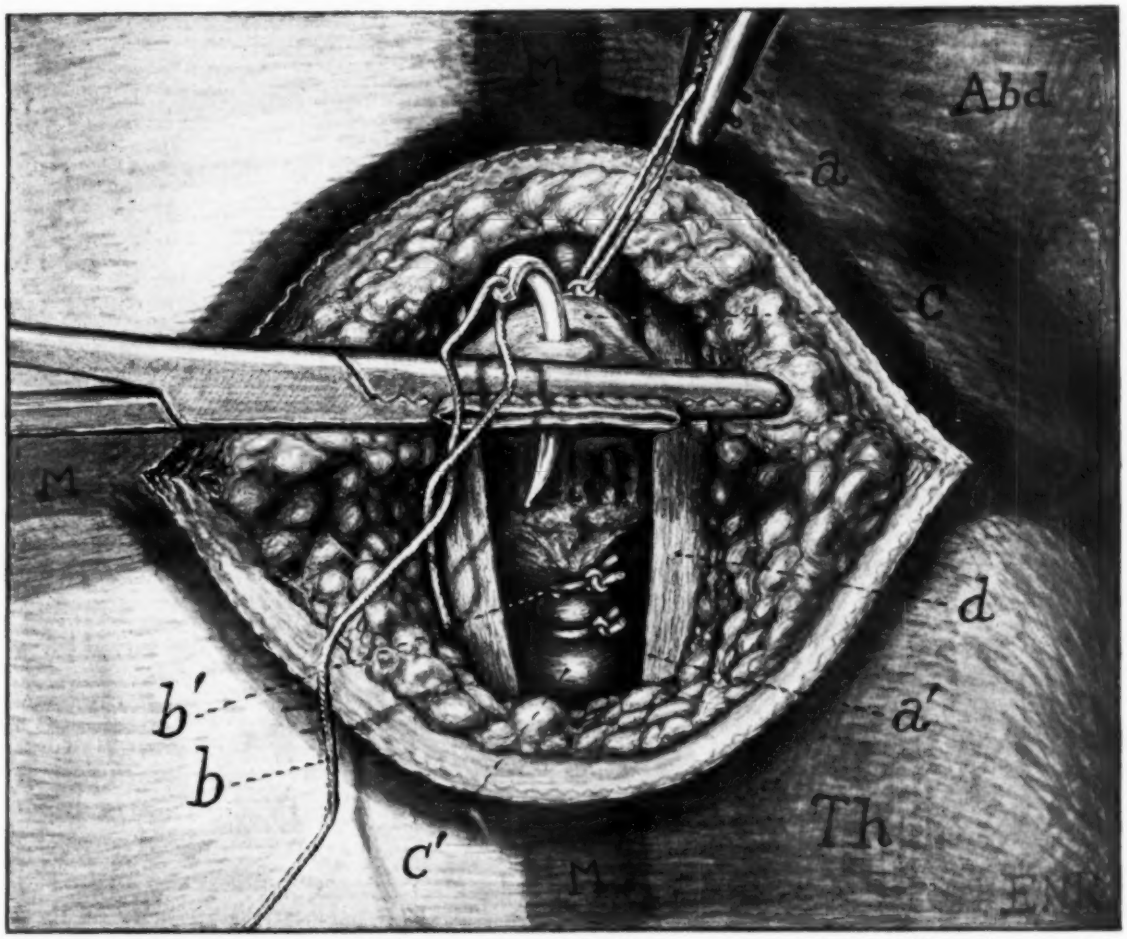

Fig. 1. a,a′, first ligature placed; b,b′, second transfixion ligature, upper end on needle; c,c′, upper and lower ends of cut saphenous vein; d, superficial fascia; M, skin marking with dye to show vein position; Th, thigh; Abd, abdomen. (× 2.)

The transfixing of the vein (Fig. 1) we feel removes much of the hazard of ambulatory ligations as far as bleeding is concerned. With this technical point included, it is impossible for either end ligature to slip off the vein, as the transfixion tie is placed between the previous ligature and the cut vein end.

COMMENT

1. The treatment is entirely ambulatory. The patient walks immediately after ligation and is not confined to bed. Some of the ligations have been done on elderly people, seventy and eighty years old and they have done as well as the younger patients. It is remarkable to see varicose ulcers of several years duration in both middle-aged and elderly people, close within three to five weeks after ligation. The diminution in pain and swelling is rapid, the ulcer granulates and is covered with epithelium quickly.

2. Several cases have had simultaneous bilateral saphenous ligation without difficulty, and ambulatory. At first we were hesitant to do both extremities at the same time. However, we had encountered no complications with single ligations, and therefore felt we should try ligating both extremities at one time.

3. The site of ligation is not determined anatomically, but by tracing the impulse in the saphenous vein, otherwise difficulty or failure to locate the vein may result. At first there may be difficulty in palpating the impulse in the thigh, but with practice the tactile sense is developed rapidly.

4. In ligation of the long saphenous vein it is necessary to ligate close to the fossa ovalis and above the site of the circumflex branches (superficial circumflex iliac, superficial epigastric, external pudendal, lateral femoral cutaneous, accessory saphenous veins), or there will be recurrence by enlargement of one of these. This is borne out by the figures in Table 1, which shows that ligation in the low or the midthigh was followed by recurrence above the site of ligation.

5. The skin sutures remain two weeks to insure complete healing of the skin and avoid breaking down of the wound. With the patient ambulatory, the wound edges are subjected to a pulling force.

6. The varicose veins are not injected for two weeks following ligation in order to allow the veins to contract of themselves after removal of the pressure of the column of blood. This makes for smaller thrombosis, better cosmetic results, and less injections. We use two sclerosing solutions, sodium morrhuate and a sodium chloride-dextrose solution, the latter for the larger veins and the former for the smaller veins. Caution is necessary in the use of the sodium chloride-dextrose solution, for any injection outside of the vein results in severe pain and necrosis. Therefore it is advisable to use a short bevel needle and to inject only the larger veins with this solution. Other more drastic and toxic solutions are reserved for the occasional refractory case.

7. In case of ligation for varicose ulcer, the ulcer is rendered clean of infection before ligation. Frequent hot, moist magnesium sulphate dressings are applied to the ulcerated area for one or two weeks, along with rest and elevation of the limb, and elastic bandage. There is thought to be a lymphangitis and a lymphadenitis of the superficial subinguinal nodes draining the infected ulcer, and ligation of the saphenous vein in this area before the ulcer is clean may result in a cellulitis or thrombophlebitis in the thigh.

CONCLUSIONS

1. Ligation of the saphenous vein in the low or midthigh is followed by recurrence above the site of ligation.

2. No recurrence has followed ligation of the saphenous vein at the fossa ovalis in those cases followed to date.

3. The whole treatment may be carried out with the patient entirely ambulatory.

4. Simultaneous bilateral ambulatory ligation has been done without succeeding difficulty.

ARTIFICIAL PNEUMOTHORAX

PRACTICAL ASPECTS OF ITS APPLICATION TO PULMONARY TUBERCULOSIS

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THE application of artificial pneumothorax, air or gas introduced into the pleural cavity, to the treatment of pulmonary tuberculosis constitutes one of the major medical advances of the past half century. With this treatment, many patients who would otherwise be undergoing prolonged confinement to bed at home or in sanatoria, are able to resume exercise and occupations much sooner while the lung is still healing. Collapse of the lung by artificial pneumothorax has become a universally accepted procedure. Through it the toxic effects of the disease are controlled, spread of infection to the hitherto unaffected lobes or to the opposite lung are prevented, and healing is hastened, so that prolonged bed rest is less necessary.

Twenty-five per cent of patients with pulmonary tuberculosis who were admitted to institutions during 1934 received initial pneumothorax treatment the same year. The increasing use of pneumothorax may be correlated with the continuous and marked fall in mortality and morbidity rate of pulmonary tuberculosis during this century. In New York State the death rate for pulmonary tuberculosis has dropped from 124 per 100,000 in 1919 to 51.8 in 1934. It has been estimated that 77 per cent of all cases today are undergoing some form of collapse therapy. Pneumothorax accomplishes economic recovery in 40 to 50 per cent of cases receiving it under the usual indications.[1]

The greater saving of lives occurs in cases with cavity in whom this therapy is instituted. Without its aid reported figures are appalling. Figures from the Trudeau Sanatorium at Saranac Lake are significant. In cases with cavity and disease of far advanced extent, without pneumothorax, death occurred in 69 per cent at the end of five years. Even more ominous are figures from studies made among patients of poorer economic circumstances with more extensive and destructive type of pulmonary pathology.

INDICATIONS

Pneumothorax is almost always indicated before an attempt is made at more radical surgery. A patient with a positive sputum and a recently developed tuberculous cavity of moderate size, about 2 cm. to 4 cm. in diameter, which persists with little favorable change despite a few weeks of bed rest should have the lung collapsed without delay in the absence of definite contraindications. Cavities of older age or of larger size, resultant from sloughing in caseous pneumonias usually indicate immediate attempt at collapse. Hemoptysis, tuberculous laryngitis, and moderately advanced tuberculous enteritis are no longer considered contraindications. By collapsing the diseased lung and closing the cavity itself, the source of production of tubercle bacilli is eliminated and the complications tend to cure.

Progressive phthisis calls for early establishment of pneumothorax to localize the lesion, when spontaneous arrest is unlikely after a brief period of observation, arbitrarily for three weeks. It should be established without delay when the process is of the acute caseous pneumonic character to combat prostrating toxemia and exhaustion, even if one anticipates progressive cavernous sloughing of tissue.

[1] MAYER, E. Cavity in the tuberculous, its management. *J. A. M. A.*, 100: 1478 (May 13) 1933.

The "allergic" or so-called exudative type of tuberculosis, often found as the subapical infiltrate, deserves careful watching for a few weeks under strict bed rest before pneumothorax therapy is instituted. This type of disease often resolves spontaneously. If not, it may go on to rapid excavation or extension. Any evidence of such change immediately calls for collapse therapy.

In Negroes who are prone to softening and liquefaction of caseous foci, particularly those in poor economic circumstances, pneumothorax should be instituted early. Patients without means to provide sanitary surroundings, good food and fresh air as is commonly the case in the dwellers of tenement districts of large cities, are less likely to spontaneous arrest of the tuberculous process than are those of more fortunate means, so that economic factors often force immediate institution of collapse therapy.

There are some workers who look upon even active minimal pulmonary tuberculosis with positive sputum as an indication for immediate artificial pneumothorax. However, considering the complications of pneumothorax, such as effusion, tuberculization of the pleura, empyema and bronchial or subcutaneous fistula, all early cases should not indiscriminately receive pneumothorax.

Pregnant women with active tuberculosis should have their disease put under control of pneumothorax during pregnancy if the disease is not of a productive nature. In even extensive exudative unilateral disease, pregnancy is often well tolerated if supported by pneumothorax.

In children and adolescents, existence even of a minimal pulmonary tuberculosis usually requires early induction of pneumothorax. It must not be forgotten that the open case is, from the epidemiological standpoint, a menace to the community.

CONTRAINDICATIONS

There are a few contraindications to the institution of pneumothorax. In the main they are cardiopathy, cardiovascular-renal disease, asthma, severe emphysema with marked reduction of vital capacity, and perhaps advanced bilateral tuberculosis with both lungs active. However, in cases with bilateral cavitation, institution of pneumothorax on the worse side may improve the lesser involved opposite lung and subsequent pneumothorax may be instituted for the contralateral lesion. Terminal enteritis and advanced laryngitis present contraindications to pneumothorax. Diabetes is not a contraindication but on the contrary, is an indication, though here the metabolic disorder must be carefully controlled.

Physiology and Dynamics of Pneumothorax. Normally there is always a negative intrapleural pressure of minus 4, minus 8 c.c. of water in expiration and inspiration, respectively, which is maintained by the pull of smooth muscle and elastic lung fibers contracting concentrically about the hilus or the center of gravity of the lung. Intrathoracic or intrapleural pressure is equivalent to intrapulmonic pressure minus the elastic pull of the lung. This pull is greater on inspiration than expiration so that the lung follows the expanding thoracic cage in response to the inflating force of normal atmospheric intrapulmonic pressure. This ballooning force along with negative intrapleural pressure and cohesive attraction between visceral and parietal pleural layers keeps the expanding lung in even contact with the chest wall and diaphragm. On introducing air between the pleural surfaces, the pull of the chest wall and diaphragm is progressively decreased as the negative intrapleural pressure is lessened. The lung is permitted to contract, and as the intrapleural pressure approaches zero, the lung continues to contract until it is completely collapsed and quiescent.

In regions of diseased lung parenchyma, with infiltrations, fibrosis, or cavities, there is increased elastic tension of lung tissue and lessened expansibility by respiratory pressure changes and consequently retraction of these parts occurs to a greater extent than normal tissue. In the absence of

adhesions inserted over the lesions, these parts are selectively put at rest while healthy lung continues to function. A selective or "hypotensive" collapse is the most ideal type of pneumothorax and is preferable to complete immobilization of the lung by positive intrapleural pressure.

Most important among factors cited as responsible for healing under pneumothorax are, (1) partial or complete rest of the collapsed lung, (2) release of elastic tension of the lung, (3) production either of pulmonary hyperemia or ischemia. Four-fifths of the air introduced in pneumothorax exerts an expanding force on the mobile thoracic cage, while only one-fifth acts to reduce lung volume. This and the expulsion of residual air from the compressed lung as well as the collapse of non-functioning parenchyma account for the very slight reduction of lung volume with pneumothorax therapy.[2] Spirographic measurements show that the vital capacity after collapse is not decreased in proportion to the amount of air insufflated. Thus, the collapsed lung continues to move and ventilate with very little diminution caused by pneumothorax, except in positive pressure pneumothorax or with pleural effusion and pleural fibrosis with paradoxical diaphragmatic motion, in which events the lung is immobilized. With an easily shifting mediastinum, the collapsed lung does not ventilate but moves as a mass with respiration. There is no interference in uncomplicated pulmonary collapse with normal oxygenation of arterial blood. In bilateral pneumothorax the two collapsed lungs maintain normal gaseous exchange.

Coincidentally, there is slowing of lymphatic circulation and toxemia and the tendency of the disease to spread is lessened. Rather than ischemia there is increased congestion and venous stasis of the lung[3] with impaired distensibility so that healing and fibrosis are promoted. Rarely, bronchial stenosis with atelectasis may be a factor though postmortem evidence for this is wanting.

Release of elastic tension by pneumothorax relieved the disease bearing area from the strain of continuous respiratory movement.

Spread of disease in the collapsed lung is extremely rare. This is true of hematogenous, as well as lymphatic and bronchogenic forms of dissemination.

PROCEDURE

Substance Injected. Filtrated air is commonly used as it is most satisfactory and practical. It has the obvious advantages of being readily available and absorbing slowly enough to obviate too frequent replacement.

Equipment should be simple and need not be expensive. A simple apparatus of the type illustrated may be installed with or without cabinet at very little expense, for office or bedside use (Fig. 1). It consists essentially of a water manometer, A, for registering intrapleural pressure. By means of a pinch-cock or two-way stop-cock, B, this may be shut off while air is administered from bottle C. By reversal of the petcock, the flow of air may be interrupted and readings taken at intervals during the administration. From bottle D water colored with green chlorophyll flows by gravity into bottle C through the connecting tubing, E, the amount entering bottle C displacing an equivalent volume of air along the tubing, F, into the thoracic space through pneumothorax needle, G. By simply reversing the bottles air may be withdrawn from the pleural cavity.

Clinical observations and experience of many workers, supplemented by mathematical computation and consideration of the physical principles involved, have been embodied in the preparation of standards and specifications for construction of artificial pneumothorax apparatus recommended by the Committee on Artificial

[2] Pinner, Max. Mechanisms of healing in collapse therapy. *Ann. Int. Med.*, 9: 501 (Nov.) 1935.

[3] Christie, R. V. Pulmonary congestion following artificial pneumothorax; its clinical significance. *Quarterly Jour. Med.* (Aug.) 1936.

Pneumothorax of the American Sanatorium Association.[4]

The calibre of the pneumothorax needle recommended is 17 to 20 gauge Luer (0.8 to 1.2 mm. in diameter), average 18 to 19 gauge Luer (or about 1.0 mm. diameter), and 2 to 2½ inches long. For the initial insufflation of air, the larger calibre is desirable, with a short or blunted bevel. Too fine a needle hinders satisfactory manometric oscillations. The needle lumen may be too readily obstructed by water from the sterilizer or by anesthetizing fluid if the syringe has been attached, or by a tiny bit of extrapleural tissue picked up on the way into the pleural cavity. A needle length sized sterile stylet should always be handy to free the needle track under these circumstances.

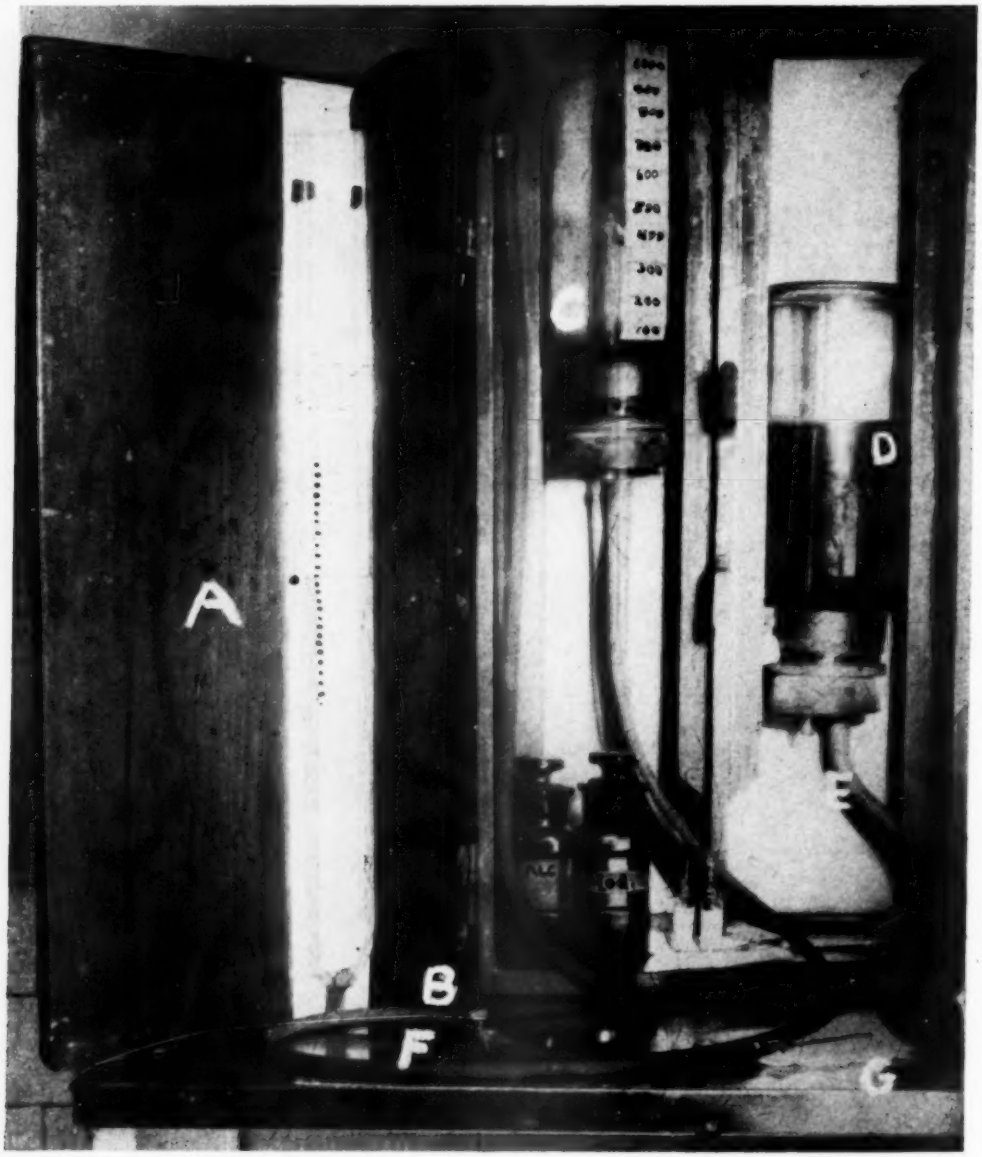

Fig. 1.

The manometer and connecting tubing should be 3 to 5 mm., but averaging 4 mm.,

[4] Peters, A., Pope, A. S., Cramer, J.: Manometric readings of intrapleural pressures in artificial pneumothorax. *Am. Rev. Tuberc.* 34: 614 (Nov.) 1936.

in diameter. Smaller bore than this is not desirable as capillary force may cause the water column to break. Connecting tubing should be of sufficient length to extend from the outlet of the pneumothorax apparatus to the needle when inserted into the patient's chest. It should be as short as feasible.

The intelligent use of the manometer ranks in importance with that of the radiograph machine and fluoroscope as a guide in pneumothorax practice. Best adapted for ordinary use is the U-tube type of water manometer calibrated 15 to 20 cm. in height above and below the zero mark. To facilitate direct reading of correct pressure, the scale should be marked off in half centimeters, each graduation being cardinally numbered and read in terms of centimeters of intrapleural pressure. If marked in centimeters directly the reading obtained must be corrected by doubling the figure. Coloring matter to aid reading, such as powdered chlorophyll or fuchsin may be used, through the vegetable dye is preferable as it is less apt to stain the glass with prolonged use.

TECHNIQUE

The patient should be placed lying on the good side with a small pillow under the dependent thorax in order to stretch apart the intercostal spaces on the uppermost or affected side. This position affords widest respiratory and manometric excursions. With the patient turned on his back, intrapleural pressures are higher due to the rising of abdominal viscera and diaphragm, diminishing the size of the hemithorax.

The rib interspace selected for the site of introduction of the needle is determined by the location of the disease. There is more likelihood of finding free pleural spaces and less likelihood of puncturing diseased lung tissue when the needle is introduced at some distance from the area of disease. Ordinarily the optimal site is the seventh or eighth interspace in the posterior axillary line, well below the scapular angle. For refills it makes no difference where the needle is inserted as long as there is good collapse and the needle is introduced at some distance from the attachment of adhesions to the chest wall as previously visualized by fluoroscopy or oblique roentgenography. In difficult cases, pneumothorax may be best administered under fluoroscopic guidance. Before the attempt is abandoned, several different sites may successively have to be tried when free pleural space is not found at the initial site selected.

In office practice we have not found necessary the adoption of formal hospital routine ordinarily used in preparation for major surgery. However, though we dispense with sterile gown and gloves and draping of the patient, meticulous asepsis is wise to obviate exogenous infection of the pleural cavity. The happier psychologic effect on the patient when the procedure is simple and unostentatious is not to be undervalued.

Tincture of iodine, 3.5 per cent, is applied over the selected site and the excess removed with alcohol. Using a 25 gauge, 1½ inch needle, an intradermal bleb is first made and through this the skin and subcutaneous tissues are infiltrated with 2 per cent procaine solution, down as near as possible to the parietal pleura. The novocaine is introduced as the needle follows close to the upper border of the lower rib, avoiding intercostal vessels and nerve.

After a few minutes the short beveled "initial pneumothorax needle" which is still attached to the novocaine-containing syringe, is inserted at a safe angle of 45 degrees with the body surface. As the parietal pleura is entered the easily movable plunger descends, permitting the suction of the negative intrapleural pressure to draw novocaine into the pleural cavity.

When this happens, the syringe is detached and the needle connected with the tubing to the manometer. With the patient breathing quietly and the needle in the pleural cavity a negative pressure minus 4 cm. water on expiration, minus

8 cm. water on inspiration will be indicated on the manometer with good respiratory oscillations. Slight oscillation of the manometer around the atmospheric level may occur with the needle just outside the parietal pleura. When a proper reading is obtained, insufflate 25 c.c. of air. Take frequent readings while giving the first 50 c.c. to preclude the possibility of the needle tip, originally intrapleural, having penetrated the lung. If the pressure is still negative introduce 50 c.c. more, continuing with small amounts periodically administered until about 200 to 300 c.c. have been introduced. The instillation should be ended with a mean negative intrapleural pressure.

Within forty-eight hours a refill is given insufflating in like manner small amounts of air with periodic manometric readings until 300 c.c. are given, leaving as before a negative intrapleural pressure. A third refill is given two to three days after the second, a fourth four to five days after the third, and subsequent refills at weekly intervals. As the degree of collapse increases, in the absence of restraining adhesions, patients may have refill intervals prolonged to ten days, to two or three weeks and more. Patients should be kept in bed for several weeks during the establishment of pneumothorax.

A definite routine should be followed in carrying out pneumothorax treatments. Refills should be frequently given, introducing amounts requisite for obliterating as promptly as possible all excavation and splinting satisfactorily the whole lesion with conversion of sputum from positive to negative. At this point only may we be assured the patient has a clinically effective pneumothorax. When symptoms and signs of activity have disappeared, the lung should very slowly and gradually be allowed to reexpand ideally to a state of selective collapse. Thus by the second or third year of treatment, the depth of collapse of the disease bearing portion may be maintained at about 10 to 20 per cent, with the remaining healthy lung actively functioning in respiration.

When no adhesions are present the desired degree of collapse may be attained without the use of positive intrapleural pressures. In the presence of adhesions, particularly those suspending a stiff-walled cavity in the disease bearing area, positive pressures are justified in order to stretch the adhesions and permit cavity closure and negative sputum. Tension pneumothorax often obviates adhesion cutting. High positive intrapleural pressures are to be used with caution as there is danger of tearing caseous foci present in the lung adjacent to the attachment of the tensed adhesion.

The patient is instructed to lie on the treated side between refills in order to prevent infected sputum from being aspirated into the bronchi of the opposite lung.

Laboratory Aids to Management of Pneumothorax. Monthly sputum examinations should reveal a progressive reduction of bacillary content to the point of conversion to negative. The rate of disappearance of bacilli from the sputum depends upon the presence or absence of pleural adhesions on the treated side or cavitation in the contralateral or untreated lung. The earliest conversion takes place in cases with unilateral cavitation and no limiting adhesions. Concentrated sputum study should be made and, during reexpansion, guinea-pig inoculation, to confirm the absence of bacilli. It is only in retrospect from this point of sputum conversion that the length of the collapse period can be properly dated.

Regular fluoroscopic visualization of the lung during inspiratory and expiratory movement is essential to the conduct of pneumothorax for determining the degree of collapse, detection of extension of the process, adhesions, complicating pleural effusions, and mediastinal displacement. *Serial roentgenograms* at three month intervals should reveal evidence of progressive resolution, organization and fibrosis, probably with calcium deposits in successful cases.

Blood sedimentation rate determination is a valuable laboratory aid to management of pneumothorax when correlated with serial blood counts and bacteriology findings, as a good indicator of cessation of pathological activity of the tuberculous process under compression. The rate of settling of red blood corpuscles parallels the degree of activity of the disease focus.

By the ratio of lymphocytes to monocytes in the differential count, and shift to the left of the Schilling polymorphonuclear index, we have an additional and perhaps more delicate measure for evaluating the activity of the tuberculous process and that indefinable something of prognostic importance which we call resistance.

ACCIDENTS AND COMPLICATIONS OF PNEUMOTHORAX

Gas embolus, carried from pulmonary veins to coronary or cerebral arteries, occurs about once in every 500 or 1000 pneumothorax treatments. Most frequently it occurs at the induction of pneumothorax. It may be prevented by making sure the needle tip is in the pleural cavity before administering air. Manometric oscillations must show a negative pressure sufficiently great to indicate that the needle is in the pleural cavity and not in a pulmonary vessel. Air introduced into the pleural cavity may be sucked into pulmonary vessels when rupture of an adhesion at its pulmonary attachment exposes the open vessels to intrapleural air. This complication has been reported as proving fatal in as many as 50 per cent of the cases.

Pleural shock, a syndrome due to irritation or puncture of the pleura may be difficult to differentiate from air embolism, which it resembles clinically, but is usually not fatal.

Spontaneous or accidental pneumothorax may result from the needle penetrating the lung, allowing the air from the lung to leak into the pleural cavity. More commonly an adhesion may rupture at its pulmonary attachment producing a bronchopleural fistula. A further cause may be extension of a subpleural focus burrowing into the pleural cavity. When a flap of visceral pleura acting as a check-valve at the fistulous opening prevents return of air from the pleural cavity to the bronchial tree, air may have to be aspirated to prevent death.

Mediastinal shifting and *herniation* may produce embarrassment of respirocirculatory nature. A weak or flexible mediastinum results in delayed rise in manometric readings with little difference in inspiration and expiration. A rigid mediastinum produces opposite effects. A mobile mediastinum may be stabilized by shortening the refill intervals and varying the amounts of air administered. At times it is necessary to stiffen the mediastinum by injection of sterile olive oil or mineral oil into the pleural cavity. Occasionally *subcutaneous emphysema* results from leaking of air directly following treatment into the tissues. The patient should be reassured it is of no significance.

During the first day following induction of pneumothorax the patient may experience a sensation of heaviness in the chest with discomfort, aching or pain. This is due to stretching of adhesions in most cases and may be controlled readily with codeine.

Pleural effusion occurs in 30 to 70 per cent or more of cases of pneumothorax. About 10 per cent of these fluids become purulent and contain tubercle bacilli. *Empyema* is most serious when it is due to mixed infections and associated with a bronchopleural or subcutaneous fistula. Of little significance is the small serous effusion which consists of fluid normally present lubricating the pleural surface. During pneumothorax this fluid gravitates to the costophrenic sinuses and may be found by careful search in almost every case. Less frequently, large serous effusions occur of low cellular, protein and fibrin content. Its formation is heralded by low grade fever and mild toxemia for several days.

Such effusions usually develop during the first three to six months of treatment

which represents the period in which the collapse is still recent and incomplete and the lung most accessible to the effects of sudden or too excessive pressure fluctuations.[5] Incomplete pneumothorax because of adhesions favors the formation of effusion. Too sudden pulmonary compression and too sudden and excessive fluctuations of pleural pressure are to be avoided as this upsets the normal correlation between ventilation and circulation in the lung. If not aspirated, fluid may remain for weeks or months. When aspiration it is carried out to relieve pressure symptoms, at times more active pleural absorption is apparently stimulated.

By diminishing the size of the pleural space the presence of pleural effusion results in abnormally high initial pressures or an abnormally high rise in pressure soon after air is administered during refill. If there is much fluid depressing the diaphragm, respiratory excursions may be absent or paradoxical diaphragmatic movement may occur.

Long standing pleural effusions favor the formation of *obliterative adhesions* with resulting loss of pneumothorax space. Perhaps one-third of pneumothoraces are abandoned in three months time for this reason. To prevent this complication frequently *oleothorax* is given.

Fibrotic and fibrinous changes resulting in eventual pachypleuritis are more promptly manifested if exudation has occurred.

In the presence of pleural adhesions restricting the pleural space, the rise of pleural pressure is accelerated on the administration of air. When adhesions are deemed severable, intrapleural pneumolysis as an adjunctive measure results in a more complete collapse of lung in 60 per cent of cases.

[5] Mayer, E. and Dworkin, M. Nature of pleural effusions complicating artificial pneumothorax. Read at the Symposium of the Metropolitan Sanatorium Conference, N. Y. Tuberculosis and Health Association, Oct. 7, 1936. To be published.

CRITERIA FOR TERMINATION OF PNEUMOTHORAX

The condition of the lung before collapse with regard to the extent and particularly the type of the original lesion, is one of the most important points in determining reexpansion. Old *x*-ray films prior to institution of treatment should be reviewed. If extensive ulcerocaseous disease with large cavity formation and marked constitutional disturbances existed, the pneumothorax should be continued for more than three years, in some cases six to seven years, if relapse would be avoided. Cavities collapsed and with negative sputum for more than two years are quite free from the danger of reactivation on reexpansion of the lung. Eighty per cent of the patients with closed cavities and who are symptom-free and with a negative sputum, as a result of satisfactory collapse of the lung, regain complete working capacity; those with uncollapsed cavities and positive sputum rarely make an economic recovery.[6] More favorable for reexpansion are lesions which under pneumothorax show changes of resolution roentgenologically, stellar fibrosis and calcification of foci. Exudative lesions may heal completely, leaving no scar. Where there was considerable original lung destruction, a phrenicectomy or partial thoracoplasty may be necessary to completely obliterate the pleural cavity. More confidence is felt in considering reexpansion in cases in whom there was conversion of positive to negative sputum, with signs of rapid cessation of pathological activity within three to six months after induction of the treatment. In younger patients even with an exudative lesion between the ages of fifteen to thirty years, reexpansion should not be permitted within three years. This is likewise a consideration with patients of poor means, especially if they must return to hard labor, or unsanitary surroundings with poor food and lack of fresh air.

[6] Mayer, E. Cavity in the tuberculous, its management. *J. A. M. A.*, 100: 1478 (May 13) 1933.

In reexpanding the lung, it is a good plan to maintain a 10 to 20 per cent degree of collapse for four to six months so that during this period the lung may be given a trial of reexpansion under conditions approximating normal activity and exercise. If the roentgenogram shows no change under this altered regime and the sputum remains negative on concentration and guinea-pig inoculation test, refills may be discontinued and the pleural space allowed to obliterate.

SUMMARY

Practical aspects of artificial pneumothorax as applied to the treatment of pulmonary tuberculosis are briefly presented for office and bedside use.

Indications for the institution of treatment are fairly clear cut. The physiologic dynamics of pulmonary compression, technical details of the operation, criteria of management and termination of collapse therapy are briefly outlined.

Included also is a discussion of accidents and complications of treatment and their management, as well as indications for adjunctive measures for securing adequate collapse as pneumocautery, phrenicoexeresis and thoracoplasty.

USEFUL ARTIFICIAL FEEDING FORMULA

GURN STOUT, M.D.

LOS ANGELES

QUITE frequently in the practice of medicine one encounters patients who present a problem which arises from many and diverse causes, as to how to meet their nutritional needs. Some patients are unable to eat due to a continuous semistuporous or comatose state resulting from conditions such as head injuries, brain tumors and abscesses, infections of the meninges, etc. Malignant tumors and occasionally ulcers in the upper gastrointestinal tract produce partial obstructions which render the retention of food difficult.

Patients may be strongly disinclined to take food due to an overpowering anorexia. This situation frequently obtains in postoperative drainage cases, especially if a malodorous one. Anorexia is common in the various types of enterostomies and in generalized peritonitis.

The taking of ordinary food in sufficient quantities when ileus (functional or paralytic) is present, quite commonly aggravates the condition and distresses the patient by increasing the tympanites.

When confronted with such a feeding problem we have used an "artificial" food formula since 1929. This was first brought to general attention when it was briefly mentioned in a paper[1] published in 1931. This formula is liquid and is administered through an indwelling Levin tube passed transnasally to the stomach or duodenum. The material is freshly prepared when needed, in amounts of one liter. The individual dose is measured and warmed to the temperature of "baby's milk" and instilled through the duodenal tube every two hours, day and night. Between feedings the "food" is kept in the refrigerator.

[1] STOUT, GURN. Gastrointestinal obstruction, functional and organic. *Ann. Surg.*, 94: 347–353 (Sept.) 1931.

On the first day the dose usually given is 20 c.c., this being increased by about the same amount daily until the patient's caloric needs are met.

The formula has a high caloric value, approximating two calories per cubic centimeter. If the amount given is increased too rapidly, nausea and sometimes vomiting result. This reaction seems to be equivalent to overfeeding the patient with regular food too early in his convalescence. It is only necessary to reduce the amount temporarily when this occurs.

We have in this manner been able to maintain patients in excellent nutritional condition over periods of eight weeks or so. Over such extended periods it is of course necessary to remove the Levin tube intermittently (every four to seven days) for a few hours in order to clean it and to rest the throat.

Before passing the tube it has been our practice to spray the nose and throat with 0.5 per cent cocaine (alkaloid) in liquid petrolatum. The tube itself being lubricated with the following:

℞	Cocaine (alkaloid)	gr. 5
	Oxyquinoline Sulphate	gr. 1
	Pulvis Caroid	gr. 5
	Petrolatum	oz. 1

The first two ingredients are for the purpose of providing anesthesia and antisepsis respectively, and the last two, to reduce the amount of mucus accumulating on the tube.

When the tube is in position, the nose and throat should be frequently sprayed with such a preparation as mistol.

From the dietetic point of view the formula seems complete in all essential particulars, for the purpose intended. It has been modified and improved from time to time and its present composition is as follows:

	Grams
Sodium chloride	15.0
Mead's Mineral Mixture No. 85	4.0
Glucose	50.0
Lactose	100.0
Dextrin	100.0
Peptone	50.0
Calcium caseinate	25.0
Bouillon cubes, beef	2
Cod-liver oil	15.0
Olive oil	15.0
Egg yolks	2
Cream 40 per cent	100.0
Yeast extract	2.0
Cevitamic acid	0.2

It is prepared in the following manner:* Measure out 500 c.c. of water and from this add a small amount to the first eight ingredients of the formula. At first use only sufficient water to make a thin paste, then gradually add the balance of the 500 c.c. Heat over a moderate flame guarded by an asbestos mat, until the mixture reaches a temperature of 44°C. (110°–112°F.). Stir constantly while heating and remove from the flame immediately this temperature is obtained, and guard against overheating. Add immediately, while still hot, the cod-liver oil and olive oil, mixing with an egg-beater. Allow to cool to room temperature and beat in the remaining ingredients. Lastly, water should be added, if necessary, to make one liter. The final preparation should be smooth and show no evidence of curdling.

* Courtesy of the pharmacists of the Hollywood Clara Barton Memorial Hospital.

SUMMARY

1. The problem of how to meet the patient's nutritional demands is oftentimes difficult.

2. Examples of such instances are mentioned.

3. The need for a satisfactory "artificial" food formula is frequently observed.

4. The composition of an "artificial" food formula that has proved clinically useful in the author's hands is given.

5. The method of preparing the formula is described in detail.

6. The manner in which the food is administered is outlined.

OPERATING ROOM SIGNALS

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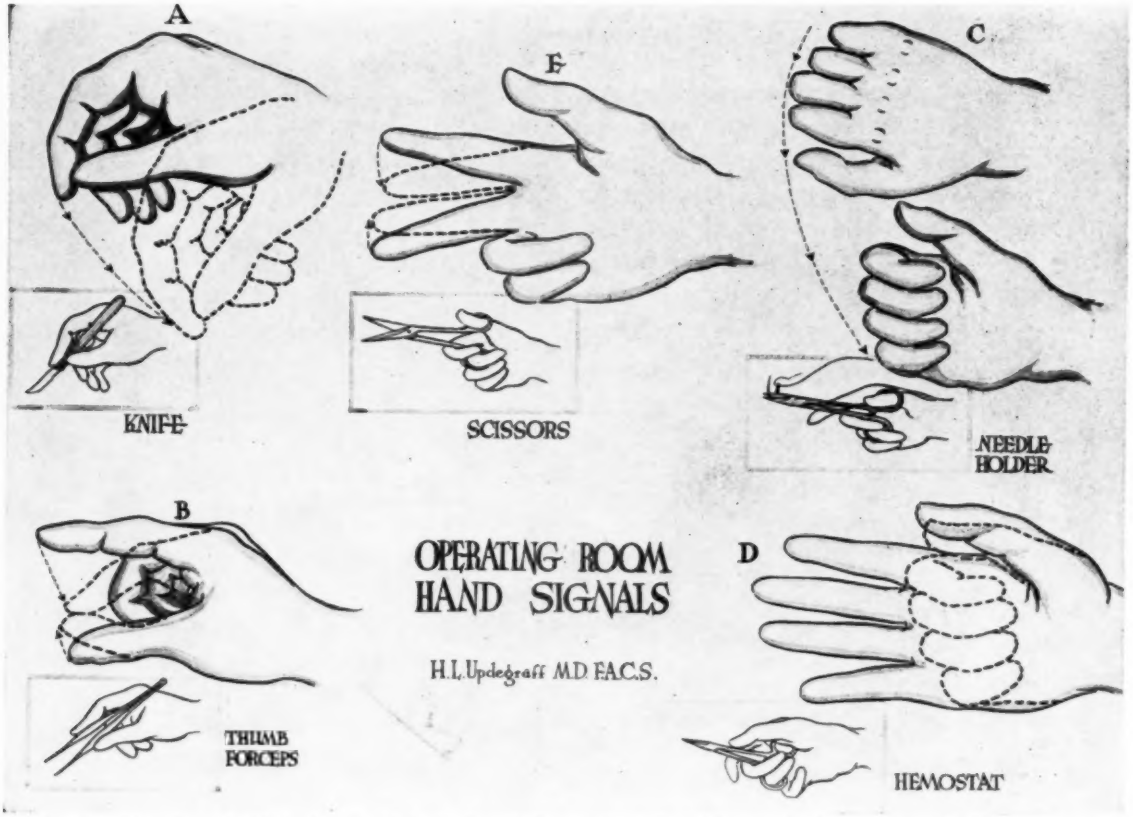
A SURGEON once was about to begin an operation on a very famous and incidentally very wealthy patient. Among other things the patient had requested, was a local anesthetic. After endless conferences, arrangements and preliminaries the morning for the surgery arrived and the patient placed on the table.



A, signal asking for a knife imitates with the hand the motion of making an incision; B, need of large or small thumb forceps may be designated by the amount of the opening between the thumb and first two fingers; C, needle holder is requested by making a rotating motion with the hand the same as that employed in using a large curved needle; D, crushing action of the hemostat is illustrated by opening and closing the hand like a hemostat had been placed in the palm; E, scissors are the easiest for which to signal as the first two fingers simulate the blades. All signals are immediately followed by holding the hand out for the instrument without removing the eyes from the operative field.

The surgeon said to his nurse, "Hand me the syringe and see that the needle is screwed on tightly." Only the strap around the table kept the patient on it. After much reassurance and tedious injection of the local anesthetic, the surgeon said, "Now hand me the knife," and fifteen minutes later the patient left the surgeon's care forever—without having had the operation or paying any fee.

Practically all surgeons have had somewhat similar experiences. Many have learned to have their instruments arranged

on a nearby table so as to be accessible without asking for them or have managed to point for what they wanted, with fair success. After pointing for awhile, I found that by imitating the use of the instrument with my hand, that my assistants soon recognized the code and in turn signaled one another.

The illustrations are not presented as something new or original, as similar routines must have been inaugurated in many surgeries. They are offered as a basis for improved variations, in the hope of stimulating smoother technique in the use of local anesthesia, either in the office or hospital operating room.

BOOK REVIEWS

RECENT ADVANCES IN GENITO-URINARY SURGERY. By Hamilton Bailey, F.R.C.S. (Eng.) and Norman M. Matheson, M.B., F.R.C.S., M.R.C.P. Price $5. Pp. 513 with 89 illustrations. Philadelphia, P. Blakiston's Son & Co., Inc., 1936.

This handy book covers the more recent advances in genitourinary surgery. No specialty, during the past few years, has undergone such changes or made advances on a wide front. Today urology is near to being an exact science and in treating these conditions a correct diagnosis can be made in nearly every case.

Therefore this compact, well written book, amply illustrated, fulfills its purpose in placing before the reader recent innovations as they affect the commoner conditions encountered in urological practice.

References to the literature are included at the end of each chapter. The Index is unusually complete.

THE THYROID. SURGERY; SYNDROMES; TREATMENT. By E. P. Sloan, M.D. Edited by members of the Sloan Clinic. Springfield, Ill., Charles C. Thomas, 1936. Price $10. postpaid.

The author organized The Sloan Clinic in 1917 and it has been said that its location has become one of the national centers in the thyroid field. We are told that at the end of 1934 over 20,000 cases of goiter had registered at the Clinic, and that operations had been performed upon 15,000 of these. From the nucleus of the physicians Dr. Sloan gathered about him, the American Association for the Study of Goiter was formed.

This work does not pretend to be encyclopedic in scope. The chapters cover General Anatomy and Physiology, Etiology, Prophylaxis, Pathology, Symptomatology, Diagnosis, Prognosis, Indications and Contraindications for Treatment, Non-surgical Treatment, Anesthesia, Surgical Anatomy, Instruments and Ligatures, Preoperative Treatment, Operative Technique, Postoperative Management, Hypothyroidism, Parathyroid Glands, Thymus, Historical, Nomenclature and Classification.

There is a Bibliography which lists 254 titles and an Index of this Bibliography; also, an Index of Subjects, and an Index of Names. There are 99 illustrations.

An interesting book and recommended to the general practitioner as well as to the surgeon who does work in this field.

UROLOGY. By Edward L. Keyes, PH.D., F.A.C.S., F.R.C.S. (Hon. England) and Russell S. Ferguson, A.B., M.D. Sixth Edition. With 343 illustrations in the text, and 17 plates, 3 of which are in color. New York, D. Appleton-Century Co., 1936.

What can one say in praise of a book that is offered to us in a Sixth Edition? That alone stamps it with the hall-mark of being standard and removed from the average. This edition is offered with every chapter rewritten "to keep pace with modern diagnosis and therapy and in particular to record the changed conceptions of the character of disease; e.g., intravenous urography, prostatic resection, calculogenesis, tuberculosis, tumor, and irradiation therapy." Adhering to this scheme a few chapters in the previous edition have been suppressed, while others have been enlarged, and some added.

We are told the junior author has, indeed, "influenced the whole, while the comments on pathology, irradiation, endocrinology and tumors" are from his pen exclusively.

Dr. John W. Draper is responsible for the chapter on "Preoperative and Postoperative Care."

We must quote the concluding paragraph of the authors' Preface: "It will, we trust, not be held against us that Cheerfulness has occasionally crept in; Cheerfulness, child of Hope, half-sister of Despair."

That the work is authoritative is understood; that it is a piece of literature the reader will discover for himself.